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WOODS
HOLE,
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THE FISHES

OF

GREAT BRITAIN AND IRELAND.

W. H. O. I.
WOODS
HOLE,
MASS.

BY

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KNIGHT OF THE CROWN OF ITALY, HON. MEMBER DEUTSCHER FISCHEREI-VEREIN, AND OF THE AMERICAN FISHERIES SOCIETY, MEMBER OF THE ASIATIC SOCIETY OF CALCUTTA AND OF THE COTSWOLD NATURALISTS' FIELD CLUB, ETC., DEPUTY SURGEON-GENERAL MADRAS ARMY, (RETIRED,) AND FORMERLY INSPECTOR-GENERAL OF FISHERIES IN INDIA.

IN TWO VOLUMES.

VOLUME I.

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PREFACE.

TWENTY years having elapsed since the last editions of the elaborate treatises on "British Fishes" by Yarrell and Couch were published, I venture to offer to the public a new work on our fish-fauna, wherein I have attempted to incorporate many of the discoveries of recent times. For latterly investigations into our fish and fisheries have been pursued with increased zeal, and many facts ascertained materially modifying some of the conclusions formerly arrived at. My desire has been to produce a work useful to the zoological student, fish-culturist, fisherman, and the general public—all of whom are more or less interested in the fish-fauna of the British Isles, whether as regards their geographical, zoological, sporting, or economic aspects.

As the value of a work of this description is much increased by illustrations, I have personally delineated every species from nature. Why I was unable to retain the services of my professional artist the subjoined letter from the Secretary to the Trustees of the British Museum* will explain.

The number of zoologists who have made the fish-fauna of our isles the subject for their special study is very considerable, as will be seen by the following list. While in addition to those who are not specially alluded to others have also done good service, either as compilers or investigators into the habits or other subjects pertaining to one or more of our indigenous species, recording their discoveries in articles sent to different scientific publications or in the pages of weekly and other journals, and which, so far as I have been able, I have referred to under the various species to which such remarks pertain.

In the year 1662, *Sir Thomas Browne* compiled a list of the Norfolk fishes, on which he made several interesting observations; in 1684, *Sir Robert Sibbald*, in "Scotiæ Prod. Nat. Hist.," describes the fishes of that country. *Willughby* and *Ray* appear to have been the joint authors of "Historia Piscium," published at Oxford in 1686; while in 1713 a posthumous work by the latter, entitled "Synopsis Methodica Piscium,"

* "DEAR SIR,—Having referred your letter of the 13th to Dr. Günther, I learn from him that as both you and he are engaged in preparing a publication on British Fishes, he thinks it inconvenient and against the interests of either work that the same artist should be employed on both. He has, therefore, intimated to Mr. Mintern that if he is working cuts for you he will engage another artist for himself. This is a matter which cannot be considered to concern the Trustees.—Yours, &c., ED. A. BOND." (*August 20th*, 1880.)

was printed in London, and in it were added some descriptions and figures of rare Cornish fishes, made by the *Reverend G. Jago*, the minister of Looe in that county. *Wallace's* "Description of the Islands of Orkney" was published in 1693, and contains an account of some of the fish. *Dale*, in a "History of the Antiquities of Harwich and Doverscourt," 1730, devotes a portion of the appendix (pp. 420-436) to the local fishes. The *Reverend W. Borlase*, F.R.S., in 1758, published a work on the "Natural History of Cornwall," in which a portion of chapter xxiii and three plates refer to fishes. *Pennant*, in his "British Zoology," 1776, devoted most of volume iii and sixty-six plates to fishes: a second edition of this work was published with additions after his death in 1812. *Donovan*, between the years 1802 and 1808, brought out his beautifully illustrated work on "British Fishes," in five volumes, containing 120 figures and descriptions. *G. Shaw*, in his "General Zoology," 1800-1819, devotes volumes iv and v (1803-1804), with 182 plates, to fishes, and has likewise observations on the same subject in the "Naturalist's Miscellany," 1789-1813. *Turton*, in his "British Fauna," 1807, devotes from p. 82 to 117 to fish. *Colonel Montagu*, in the "Wernerian Memoirs," 1811 and 1818, has some observations and figures of new and little-known British fishes. *Patrick Neill* gives a "List of the Fishes found in the Frith of Forth" (pp. 526-555), in the "Wernerian Memoirs," for 1811. *C.* and *J. Paget*, in their "History of Yarmouth," *Hogg* in the "Natural History of Stockton-on-Tees," 1829, and *Lubbock* in the "Fauna of Norfolk," 1845, refer to the local fishes. In 1813, the "Fauna Orcadensis," by the *Rev. George Low*, minister of Birsa and Harray, appeared; it had been written between the years 1774 and 1795, and from page 167 to 230 are given to fish. *Fleming*, in 1828, in a "History of British Animals," devotes pp. 162-222 to descriptions of fishes. In 1828, *Mrs. Bowdich* published some plates of British Fresh-water Fishes. *Jenyns*, in a "Manual of British Vertebrate Animals," 1835, describes the fishes (pp. 306-524). *Yarrell*, in 1835, commenced the first edition of his "British Fishes," completed the succeeding year in two volumes, and illustrated with nearly 400 wood engravings; the second edition was published in 1841, and the third by Sir J. Richardson, F.R.S., in 1859. *Parnell* published his "prize essay on the natural and economical history of the fishes, marine, fluviatile and lacustrine, of the river district of the Firth of Forth," in the "Memoirs of the Wernerian Natural History Society," vii, 1838, pp. 161-460, with plates xviii to xliv. *Johnston*, in 1838, at the annual meeting of the Berwickshire Naturalist's Club, gave a list of the fishes of that county. *Swainson* describes "Fishes in Lardner's Cabinet Cyclopædia," 1839, with figures. *Sir W. Jardine*, F.R.S., "British Salmonidæ," in 1839, with large folio plates. *Meynell* gave a paper on "the Fishes of Yorkshire" to the British Association in 1844. *Dillwyn*, on the "Fauna and

Flora of Swansea," 1848, chapter iii, from page 11 to 17, being on the local fish-fauna. In 1851, *Mr. Adam White* and *Dr. John Edward Gray* published a "List of the specimens of British Animals in the British Museum," fish occupying 162 pages. *Baker* gave a paper on the "Fishes of Somersetshire," in 1851, to the "Somersetshire Archæological and Natural History Society," in the proceedings of which it is published. *Harris*, in 1851, published in volume ix of the "Zoologist," a "List of the fishes of the Moray Firth;" *Gordon*, in 1852, in the same publication, also gave a list of those from the Moray Firth. In the same year *Peach* gave a paper to the British Association on "Some fishes found at Peterhead." In 1853, *W. Baikie* gave a list of the "Fishes of the Orkneys and Shetlands," in the "Zoologist." *Dr. A. Günther*, F.R.S., published between 1859 and 1870 a "Catalogue of the Fishes of the British Museum," in eight volumes. In the appendix to *Ferguson's* "Natural History of Redcar," is an account of the fishes of that locality. In 1860, *Mrs. Merrifield*, in "A sketch of the Natural History of Brighton and its Vicinity," gives a chapter on the "Fishes." In 1861, *Mr. Higgins* published in the "Zoologist" "Remarks on some of the fishes of Weston-super-Mare." *Couch* commenced his "Fishes of the British Isles" in 1862, and completed them in 1865, in three volumes, with 252 coloured plates. In 1864, *Gill* published in the "Proceedings of the Academy of Natural Science of Philadelphia," 1864 (p. 199), a paper "on the affinities of several doubtful British Fishes." *McIntosh*, in the "Proceedings of the Royal Society of Edinburgh," volume v, 1862-65,* gave a paper on "the Fishes of North Uist," and in 1874, in a work on "the Marine Invertebrates and Fishes of St. Andrews," describes the latter (pp. 171-185). *Dr. Lowe*, in the "Transactions of the Norfolk and Norwich Naturalist's Society," 1873-74, published an account of the "Fishes of Norfolk." In 1875, *Mr. E. Parfitt*, in the "Transactions of the Devonshire Association for the Advancement of Science and Literature," gave an account of the "Fishes of Devonshire." In 1876, the investigations of *Edward* in Banffshire were published in "the Life of a Scotch Naturalist," and a list in the appendix (pp. 417-429). *Mr. G. Sim* includes the observations made by the late *Dr. Dyce*, in a "Catalogue of fish found in the vicinity of Aberdeen" in the Transactions of the local Society in 1878. *Mr. Dunn*, in the "Journal of the Royal Institution of Cornwall," no. xxii, gave "Remarks upon some Cornish Fishes." *Mr. Frank Buckland*, in 1873, published a "Familiar History of British Fishes," enlarged in 1880, and termed a "Natural History

* Subsequent to the publication of part viii of this work and the completion of the addenda, Dr. McIntosh kindly forwarded to me a specimen of *Lumpenus lampetræformis*, which Blennoid had been trawled fifteen miles off St. Abb's head, and the first recorded British specimen (*see* "Proceedings of Zoological Society for June," 1884, with a figure).

of British Fishes," with woodcuts. In 1879, *F. Day*, in the "Proceedings of the Zoological Society" (p. 742), gave an acount of the "Fishes of Weston-super-Mare." In the same year, the *Reverend Mr. Houghton* published an account of the "British Freshwater Fishes," with coloured illustrations. In 1881, *Mr. Eagle Clarke* and *Mr. D. Roebuck* brought out the "Yorkshire Vertebrata," in which pp. 99-133 are devoted to fish. In 1882, *Mr. F. Sawyer* gave a paper to the "Brighton and Sussex Natural History Society" on "Sussex Fish and Fisheries;" and *Mr. Crellin* has compiled a list of the "Fishes of the Isle of Man."

In Ireland, *Dr. Rutty* (1772) published an "Essay towards a natural history of the county of Dublin," and in volume i, from page 345 to 369 is devoted to fish; also *Harris*, in the "History of County Down," 1744; *Sampson's* "History of Londonderry," 1802; *McSkimmin's* "History of Carrickfergus;" *Dubordieu's* "History of County Down," 1802; all have local lists of fish. *Templeton's* "List of Fishes of Belfast" was published in the "Magazine of Natural History," in 1837. In 1856, *Thompson's* "Natural History of Ireland" was brought out, and in volume iv, pp. 69-268, are collected the various ichthyological papers written by that author. *More*, who also published a list of "the Fishes of the Isle of Wight," gave in the "Journal of the Royal Dublin Society," volume v, 1866-70, a paper on the "Fishes of the South-Western Coast of Ireland." In 1869, *Andrews* likewise published a paper on the same subject.

It now becomes my pleasing duty to offer my sincere thanks to those who have assisted me by obtaining information and specimens, or have helped my work through the press. Among the former I must particularly allude to *Mr. Matthias Dunn*, of Mevagissey, whose intimate knowledge of fishes and unwearied search after information and specimens, which he has always been most ready to communicate, have proved of invaluable service. The late *Professor Peters*, Director of the Berlin Museum; *Professor Hubrecht*, of Utrecht; and *Professor Giglioli*, Director of the Vertebrate Museum at Florence, have likewise given me much assistance. *Mr. Sim*, of Aberdeen; *Mr. Kermode*, of the Isle of Man; *Mr. T. Carrington*, F.L.S., late of the Westminster Royal Aquarium; *Dr. Murie*, F.L.S., and *Mr. G. Brooks*, F.L.S., have all assisted me with specimens of marine and fresh-water fishes. *Sir J. Ramsay Gibson-Maitland, Bart.*, F.L.S., has also afforded me invaluable information and opportunities of investigation at his justly celebrated Howietoun Fisheries.

I have also to offer my best thanks to *A. C. Brisbane Neill, Esq.*, of the Madras Medical Service (retired) for his invaluable assistance in carrying this work through the press, and thus enabling me to bring out the various numbers at the periods specified in the original prospectus.

INTRODUCTION.

When commencing to investigate fish and fisheries, it naturally first occurs to the inquirer to ask what is a fish? at what geological epoch of time did it first leave a trace of its existence on the surface of the globe we inhabit? how does it live, move, and continue its kind?

In a work like the present, a small space only can be given to some of these various questions, and I have deemed it best to abbreviate remarks upon embryology, comparative anatomy and physiology, as well as the numerous and diversified systems of classification (referring the reader to the various treatises on these subjects) in order to dwell more particularly upon facts that come especially to the notice of the field-naturalist, fish-culturist and fisherman.

For practical purposes it is highly desirable to endeavour to ascertain what are the geographical limits within which the various forms of fish life are found, should the species be migratory, the causes of their migrations, and how such are dependent on ocean circulation, currents, seasons, temperature, food, or the necessity for the continuation of their kind. Why is it that some forms flourish and increase while others dwindle away and decrease; what are the effects of light or darkness, depths or the varied physical conditions of the waters in which they reside? Likewise how fish are affected by storms and electrical disturbances, or in short what are their enemies or their friends, and conditions tending towards the perpetuation or extermination of their race?

When inquiring into what is their favourite food, we have to remember that in selecting such they must be guided by the faculties of sight, taste, or smell, perhaps assisted by touch, and possibly by sound, and this leads on to the consideration of respiration and digestion. Fishes likewise possess emotions and instincts, sensibility to pain or the reverse, modifications of form sometimes due to age or sex, and alterations of colour consequent upon the nuptial season, external relationship or disease.

Some residing at great depths or in dark caverns have their eyes deficient, others in the abysses of the ocean possess them enormously developed in order to utilize every ray of light, while a few likewise living in apparently

similar conditions emit light. Again we find forms seeking refuge in other animals, or else as commensals using them as vehicles for conveying them from one place to another, or fastening on their neighbours for their own carnivorous purposes. Then there is the breeding of fishes whether natural or artificial, hybridism and its effects, sterility and its causes; diseases and the mode of destruction of fish; and lastly, fisheries, and how they are worked.

Fish are the lowest class of the vertebrate division of the animal kingdom, destined to pass their lives in a watery element, and having their bodies very diversely modified in order to accommodate them to varied conditions of existence. Some are fitted for salt waters, others for those that are fresh, some for residing at great depths, others for shallows, some are mere surface swimmers pursuing their finny food, while others, although similarly surface swimmers, live on minute organisms, and are themselves pursued by their more powerful neighbours. Some like clear water, others prefer that which is muddy, the rapid stream, the whirling eddy, the placid lake or pond, or the mountain torrent, each possess their fish life, modified according to circumstances and frequently changing with the age of the animal.

EXTERNAL CHARACTERS.

Remarking generally on the external form of fishes we see a comparatively large head attached directly to the trunk without the intervention of a neck, while the body tapers off towards the posterior extremity. The regions into which they are externally divided are those of the *head*, the *body or trunk*, the *tail* and the *fins*. In such forms as the perch or carp and the majority of species the head is separated from the body or trunk by the gill-openings; while the body and the tail have the vent as a division between them. While external similarity in form is occasionally more symptomatic of an agreement in the diet on which they feed than on their zoological relationship.

In this class of animals modifications of form from what are seen in the more typical perches or carps are exceedingly numerous. The body may be laterally flattened, as in the sole (plate cvi) strongly depressed as in the skate (plate clxvi), shortened as in the sun-fish (plate cxlviii), elongated and rounded as in the eel (plate cxlii), elongated and compressed as in the scabbard-fish (plate li), shortened and rounded as in the globe fish (plate cxlvii), or encased in square armour as in the box-fish *Ostracion*, or the pipe fishes (plate cxliv). The head may, when compared with the size of the body, be enormously developed as in the frog-fish (plate xxix), or produced laterally as in the hammer-headed shark (plate cliv), or the snout may be lengthened

into a weapon of offence as in the sword-fish (plate xlix), or the gar-fish (plate cxxvi), while the tail-fin may be elongated for a similar purpose as seen in the fox-shark (plate clvii), or the tail may be capable of prehension as in horse-fishes (plate cxliv, fig. 7). Some are possessed of organs for attachment as seen on the top of the head in the sucking-fish (plate xxxix), on the chest as in the lump-sucker (plate lv) and *Liparis* (plate lvi), or the mouth may be formed for this purpose as in the lampreys (plate clxxviii). In Asia we see a few carps have an adhesive organ behind the lower jaw, as in *Discognathus*, while some sheat-fishes as *Pseudecheneis* have them on the chest, thus enabling them to reside in mountain torrents or rapid streams.

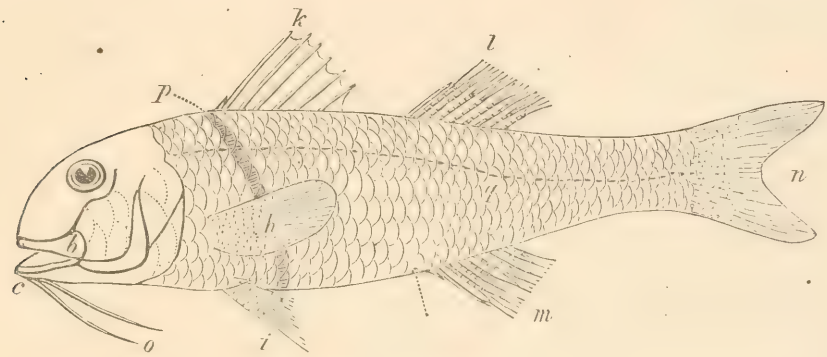


Fig. 1. Red Mullet.

b, maxilla; *c*, mandible; *o*, barbel; *h*, pectoral fin; *i*, ventral fin; *k*, first dorsal fin; *l*, second dorsal fin; *m*, anal fin; *n*, caudal fin; *q*, lateral-line; *p*, lateral-transverse line.

The *head* is as a rule divided from the body by the gill-openings, while the eye sub-divides it into two parts, that in front of this organ being known as the ante-orbital and that behind it as the post-orbital region: in the former is the snout wherein are placed the nostrils and generally the mouth. The space between the orbits is known as the inter-orbital region, while that below the orbit is the infra- or sub-orbital.

The *mouth* is subject to great diversity in its external direction, being either horizontal, oblique, or almost vertical. In some it is semi-circular or even circular in the lampreys, and inferior in most of the sharks. It may be very or only slightly protractile, and possess or be deficient in lips: and sometimes provided with accessory tactile organs in the form of barbels (fig. 1, *o*).

The gill-covers or opercles in most bony fishes, consist of four pieces, the posterior and upper of which is the opercle or operculum (page xv, fig. 3, *o*), in front of it the preopercle (fig. 3, *p. o*), while of the two lower pieces the posterior is known as the sub-opercle (fig. 3, *s. o*), and the anterior, situated below the preopercle (and sometimes rudimentary or absent), as the inter-opercle (fig. 3, *i. o*). Although in teleosteans, ganoids and holocephala

among the elasmobranchs we perceive as a rule a single external gill opening on either side, or even on the lower surface of the head, a different distribution is generally seen in the plagiostomes which possess from five to seven, and among the cyclostomes, which usually have seven as in lampreys, although it may be single as in the hag; in these latter, gill-covers as observed in teleosteans, are absent.

The *body* or trunk commences behind the head, and amongst most bony fishes is somewhat wedge-shaped, passing by imperceptible degrees into the tail or caudal portion, the vent generally dividing the two regions, but to this rule there are many exceptions, for in certain genera the intestine opens under the throat or near the caudal fin. In some slow-moving or bottom fishes, the head as in the frog-fish, is depressed, while the entire body may be compressed into a flattened disc as among the flat-fishes or pleuronectoids which progress swimming on their sides. Or there may be lateral compression conjoined to a short body and slow movements as in the dory or the sun-fish; or there may be lateral compression with a lengthening of the body as in the band-fishes. The body is divisible into the back, the sides or lateral surfaces, and the abdomen or the belly.

The *tail* or that portion which is continuous with the trunk, is similarly divisible into the back, the sides and abdominal surfaces, while should a free finless portion exist between the hind fin of the back and the tail fin this is termed the peduncle or free portion of the tail. Among the Chondropterygii the tail of some rays and skates appears as a slender appendage from the body, while in some ground forms it seems to act mostly as a rudder.

The *skin* may be scaled or scaleless, or enclosed in armoured plates, while should a row of pierced scales pass along the sides they are known as the lateral-line (fig. 1, *q*), the number of scales on which are generally important as assisting in discriminating the species; while the lateral transverse-row (fig. 1, *p*) is of similar use.

The number of *fins*, as well as their relative positions on the body, are subject to great diversity; the presence or absence of some, their situation, and even their component parts furnishing characters often useful in classification. If we examine the composition of the fins, we perceive among the bony or teleostean fishes that they consist of two distinct characters of rays, the first being spinate or having spines destitute of any tranverse articulations, and each ending in a hard or sharp point; the second being softer, more especially termed rays, and being simple or composed of numerous pieces articulated one to another by transverse joints, and which rays may have their outer extremities branched or else simple and undivided. But irrespective of the foregoing three forms, modifications are seen as in the outer ray of the pectoral of many siluroids, or in the anterior dorsal rays as in the barbel (plate cxxxi), where one or more may take on a bony character, but still

during some period of their existence may be found to have the outer end articulated. Long and delicate filaments are sometimes developed in connection with fin-rays, and often indicate that the example is young, as in a horse mackerel, *Caranx gallus*, wherein their length diminishes with age, similarly in the dory; still they are occasionally continued through life, as in an Indian barbel, *Barbus filamentosus*, and have likewise been found existing in fishes taken from the deep and nearly still abysses of the ocean. Acanthopterygians are forms which, as a rule, possess in their fins some true spines, which are absent in the soft-rayed or malacopterygians.

The fins are divisible into such as are single and unpaired, hence termed "azygous," as those along the median line of the back or dorsal, which when present may be variously subdivided or modified; the tail or caudal fin as a rule is placed vertically at the posterior extremity of the caudal portion of the body, where it is seen in two very distinct types, in the generality of fishes the two lobes being equal, when it is termed "homocercal," as in the perch; whereas in the sharks and some other allied classes the vertebral column is prolonged into the upper half of the caudal fin, rendering it unequally-lobed or "heterocercal." The anal commonly commences behind the vent, and passes along the median line of the lower surface; it may be as variously modified as the dorsal. These median or unpaired fins are considered by some to be appendages to the skin, but believed by Balfour to be the specialized and highly-developed remnants of a once continuous lateral fin along either side.

But most fishes likewise possess two pairs of horizontal or paired fins, one on the breast or pectorals corresponding with the anterior extremities of higher vertebrata; while the second or ventral pair, the homologues of the legs or hind pairs of limbs, when present are variously placed, as under the throat when they are termed jugular, as in the cod (plate lxxviii), below the pectoral fins or thoracic, as in the perch (plate i), or abdominal when near the hind end of the body, as in the carp (plate cxxix).

Fins may likewise alter with age, thus their proportionate lengths and development in the young of abyssal or deep-sea fishes, as well as in pelagic forms or those whose sphere of existence is usually restricted to the upper waters of the open sea, would seem to be frequently very different to what obtains in the adult, having caused the immature to be classed in a separate genus from the same fish when it has attained to its full size. Thus the young of the abyssal *Luvarus Cuvieri* (plate xliii and vol. i, page 120), has been described as *Diana semilunata*. The pelagic sword-fishes (plate xlix and vol. i, page 148) have in their earlier stages single, elongated, many-rayed dorsal and anal fins, but the anterior portions of both become atrophied with age, while the central rays disappear, thus leaving two fins in either position. In the pilot

fish (plate xlv) the anterior dorsal fin of the fry becomes converted into free spines in the adult. The black pomfret, *Stromateus niger*, when young has ventral fins present, causing it to have been placed in a distinct genus, *Apolectus stromateus*. While in the paired fins we find in the pelagic tunny (plate xxxvi) that the pectorals become elongated with age, and Gill observes that in the apodal or forms without ventral fins the body is eel-like or elongated. I have remarked that a variety of form exists in our ten-spined stickleback (vol. i, page 245, plate lxviii, fig. 4), in which these latter fins are entirely wanting.

Another mode in which fins change with age is owing to the spines, as of the dorsal fin, not augmenting in length so rapidly as the soft rays, consequently they may be comparatively shorter in the adult than in the young. Even the soft rays in mature fish are commonly less in their proportionate height to the entire length of the specimen than they are in the immature. The same thing occurs in respect to anal spines, the second being sometimes the longest in the immature, but becoming shorter than the third in the mature, which appears most frequently to take place when the second spine is the strongest, augmenting in thickness while the third increases in length. Occasionally there is an excess of a spine and a deficiency of a ray in the dorsal fin, the anterior one of the latter having assumed a spinous character, a not infrequent occurrence among the Sparidæ: or several articulated rays may be similarly changed. In some forms the number of rays, as in the Cottidæ, would seem occasionally to decrease as the species is found further south. Spiny-rayed fish, preying upon their weaker neighbours, appear to be more numerous in seas than in fresh waters, while in our inland waters members of the carp and salmon families usurp their place, these latter being provided with articulated fin rays.

Fin rays when broken may again unite, if lost they may likewise be occasionally reproduced, but often in an incomplete manner. Injuries to the caudal portion of the body sometimes cause remarkable changes in the form of the fin, thus in a sole (vol. ii, p. 40) will be found the description of a specimen in which the caudal fin in being reproduced has become continuous above and below with the vertical fins. In an elongated *Coilia* of the Indian seas I have several times seen that a forked caudal fin has replaced the last fourth or fifth of the caudal portion of the body, which probably had been lost by accident.

Not only do the component portions of a fin become greatly altered, but the fin itself may be very dissimilar to what we find in a typical perch or carp. Thus the dorsal fin is entirely absent in the electric eel, *Gymnotus*, of South America: it may be a long single fin, the front portion be spiny, as in the sea-perch (plate v), or with only soft rays, as in the sole (plate cvi); or the fin may be in two portions, the first being composed of spines, and

the second almost entirely of rays as in the red mullet (plate viii), or consisting of soft rays only as in the rock-ling (plate lxxxix); or the fin may be divided into three parts as in the cod-fish (plate lxxviii) and many other gadoids. The anterior portion of the dorsal fin may be in the form of free spines as in some of the sticklebacks (plate lxviii), or the free spines may be modified into tentacles as in the angler (plate xxix), or into an adhesive apparatus as in the sucking-fish (plate xxxix). Or the posterior portion of the dorsal fin may be present in the form of free rays as in the tunny (plate xxxv), or it may be simply a fold of skin containing fat as in the salmon (plate cx), which in some conditions of embryonic or early life may be observed to contain fin rays as in certain salmonoids and siluroids. When spines are present in the dorsal fin they are usually in its anterior, and rarely in its posterior portion; but in one British form, the viviparous blenny, a few are present with articulated rays anterior and posterior to them (plate lxi). This fin may likewise unite with the caudal, the latter being continuous with the anal, as observed in eels (plate cxlii). The spines and rays of which fins are composed can be erected or depressed at will, while some osseous and frequently posteriorly serrated rays or spines have a peculiar joint at their base, which prevents their being depressed in a direct line, as in the trigger fish (plate cxlvi).

The pectoral or breast fin may be absent as in some pipe-fishes, marine-eels, &c., but when present is subject to many modifications and assists in the performance of functions which at first sight would hardly appear to be among its duties. Its position is behind the gill-openings, but its form differs; thus among the Pediculati, as the angler, it possesses a sort of arm due to prolongation of the carpal bones, enabling its possessor to employ the organ as a foot or arm, and thus adapting it for moving about at the bottom of the sea; similarly some of the goby family in tropical countries are enabled to use this fin for progression over the moist mud. Or the pectoral fin may be considerably elongated as in the flying-fish (plate cxxviii), by which it can be used as a parachute in order to pass through the air. Portions of the fin may likewise be modified, thus some free rays may exist at or near the base of the pectoral fin, and subserve the function of feelers as in the mango-fish and other polynemi, or these free rays may be shorter and thicker as in the gurnards (plate xxii), when they become not only useful as a tactile organ but also for progression. In some forms this difference in the character of the rays also exists when forming an undivided fin, thus in the pectorals of blennies, as in the common shanny (plate lx, fig. 2), there are thirteen rays, the upper seven of which are shorter and more elastic than the lower six. Under certain circumstances these upper rays are useful in respiration, as in cases wherein a deficiency of air exists in the water, when they are constantly in motion, sending a current towards the gills. In very

young fish, as salmonoids prior to the absorption of the umbilical vesicle, the gills remain more or less uncovered by the opercles, and these fins are constantly employed in assisting respiration. The six thicker lower rays of the shanny are thus enlarged and stiff, as they are constantly employed resting upon or against rocks during progression. In rays and skates this fin is very largely developed.

The ventral fins are those which are most frequently absent, not only are they wanting in the large eel-like or apodal class, but occasionally their absence may not even indicate the specimen being distinct from the form which possesses them, as remarked upon respecting the ten-spined stickleback, while their position when present is frequently found to be in widely different localities on the body (see page ix *ante*). It is usually a narrow fin consisting of but few rays, while these may be of most diverse appearance. It may be restricted to a single spine useful for protective or aggressive purposes as in the little sticklebacks (plate lxviii), or in the more developed unicorn-fish, *Triacanthus*, of the Eastern seas; or it may be a simple bony ray having a broad extremity as in Bank's oar-fish (plate lxiv). Or its first divided ray may be elongated into a tactile organ as in the burbolt (plate lxxxvii), or the two fins may be conjoined forming an adhesive sucker as in the gobies (plate lii), or reduced to stiff rays for progression as in the blennies (plate lx).

The anal fin may be absent, or if present subdivided as the dorsal, it likewise when possessing spinous rays has them in the anterior portion of the fin, while its last few rays may be in the form of finlets as observed of the dorsal fin.

The caudal fin may be absent as in Bank's oar-fish (plate lxiv), indistinct and often wanting as in some pipe-fishes (plate cxliv), single and with a rounded posterior extremity, as in some gobies (plate lii), or with the central rays rather elongated, giving it a lanceolate form as in some tropical gobies, lunated or emarginate as in the grey mullet (plate lxvii), cut square at its extremity as in the wrass (plate lxx). In most bony fishes the tail consists of an upper and lower portion which although rarely of exactly the same size are still nearly so: it may be lobed as in the mackerel (plate xxxii), while one or more of its rays may be prolonged: in one form of visitor to our seas the fin is placed somewhat vertically at the end of the tail, as in the vaagmaer (plate lxiii). In forms as Chondropterygians wherein the tail is heterocercal the spine is continued into the prolonged upper lobe.

Locomotion is doubtless the main use to which the fins of fishes are put, but even in locomotion other forces are frequently or rather generally brought into play to assist the fins, whether such is for the purpose of swimming, as in the generality of this class, walking as in the angler or frog-fish, leaping as the salmon while ascending rapids when the muscles of the tail are of

great assistance, flying as in the flying-fish, floating as in the globe-fish aided by the air sac, creeping under nets as the bass, springing over them as in the grey mullet, retrograde wriggling as in congers or in some of the pipe-fishes and which is carried out solely by means of the muscular system.

Animals having such diverse forms of bodies and such variously constructed fins as exist in fishes have as a consequence their powers of locomotion modified. In such as are enclosed in bony cases as the box-fish or Ostracion voluntary progress can only be made by means of the fins, whereas in almost finless forms, as in some eels, movements of the body itself must be the motive power. During rapid progression the paired fins are pressed closely against the body, as may be observed in a mullet when pursued, or a gurnard, but which latter widely expands its pectorals when swimming leisurely along. Swimming forwards is principally effected in fishes by means of lateral or right and left strokes of the caudal portion of the body aided by the caudal fin, while gentle progression in the same direction may be effected by slight undulations of the caudal fin-rays. Flat fishes, as soles, produce a forward motion by vertical or up-and-down strokes of the caudal portion of the body. The flexible bodies of sharks may bend in more than one curve when moving rapidly, which is mainly effected by powerful lateral strokes. Among rays and skates the broad pectoral fins by means of an undulating movement effect this; while the angel-fish (plate clxiii), has a sort of mixed motion. In some forms, as the horse-fishes or hippocampus, the dorsal fin rapidly undulated from end to end after the manner of an archimedean screw, is the chief motive power. In eels, wherein fins are very deficient, forward motion is effected by snake-like curves of the body.

The pectoral fins are largely employed in keeping the body properly balanced, or raising the head, and when one of these fins is removed, the body falls over to that side, or should both be thus treated, the head sinks: it being largely developed in most sharks and rays, often compensating for the absence of an air-bladder. It can assist in a forward movement by rapid strokes towards its body, and likewise in a backward movement by means of reversed or forward strokes. Also, as already observed, it may be enormously developed as in the flying-fish and form a parachute enabling it to pass through the air in order to escape from its enemies. The vertical fins likewise assist the pectorals in maintaining the proper balance of the body, and incline it to one side when only one fin acts, or they are able to depress it by their joint action.

The dorsal and anal fins are mostly restricted in their functions to increase or diminish the extent of the lateral surface of the fish by means of their being elevated or depressed, and so prevent violent lateral oscillations, or the

body being turned upside down. There is one exception however to this, as the sun-fish, wherein the dorsal and anal fins by means of rapid undulations assist the fish in locomotion; while a similar action has been observed upon as seen in the dorsal fin of pipe-fishes.

Experiments made upon ordinary shaped osseous fishes have demonstrated that should the dorsal and anal fins be removed they roll from side to side; if one pectoral is cut off they fall over to the side from which it has been removed; if both, the head sinks: should the pectoral and ventral of one side be gone, equilibrium is lost; while removal of the tail fin interferes with progression.

SKELETON.

The skeleton or endoskeleton of fishes differs widely in the various orders, the bones being less dense in their structure than are those of the higher vertebrates. In some the skeleton is cartilaginous, in others fibrous or osseous, while two or more varieties of structure may co-exist in one fish. Among those obtained from great depths in the ocean some at least have their bony and muscular systems but feebly developed, and but loosely connected together by ligaments.

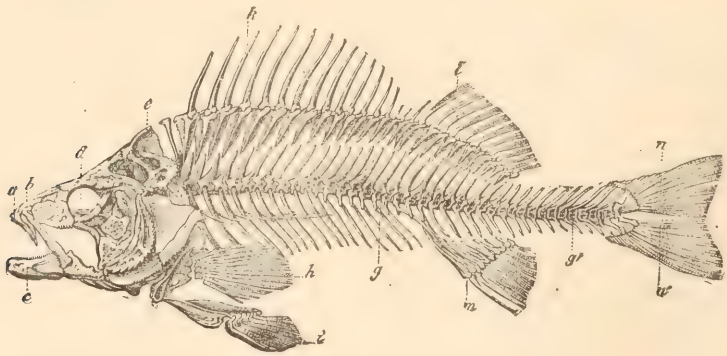


Fig. 2. Common Perch.

a, premaxillary; *b*, maxillary; *c*, dentary; *d*, orbit; *e*, cranium; *f*, interopercle; *g*, *g*,' vertebral column; *h*, pectoral fin; *i*, ventral fin; *k*, first dorsal fin; *l*, second dorsal fin; *m*, anal fin; *n*, *n*,' caudal fin.

If we examine the skeleton of a teleostean fish, as a perch, we see a framework consisting of a vertebral or spinal column, a skull and fins. The vertebral column consists of a varying number of bones or vertebræ, the bodies of which are excavated at each end, rendering them biconcave or amphicœlous.* The cavity thus produced by the apposition of two

* The vertebræ of the exotic bony pike are "opisthocœlous," or concave posteriorly and convex anteriorly.

concave bones is covered in by connecting ligaments, and filled with a gelatinous substance, the remains of the notocord: consequently, elastic balls of semi-fluid consistence exist between each vertebra, enabling them to move very freely one upon another.

The abdominal vertebræ, or those belonging to the trunk, have two superior or dorsal processes, which pass upwards and coalesce, forming an arch, the neural arch, which contains the spinal cord. At the summit of this arch is a spinous elongation, the neural spine. Two transverse processes generally pass outwards from the body of each vertebra, and to them ribs are commonly articulated.

The caudal vertebræ, or those of the tail, are furnished with neural arches, and spines as in the abdominal region, but well-developed transverse processes are deficient, while along the inferior surface of the bodies of each vertebra is an arch, similar to the neural arch on its upper edge, and this

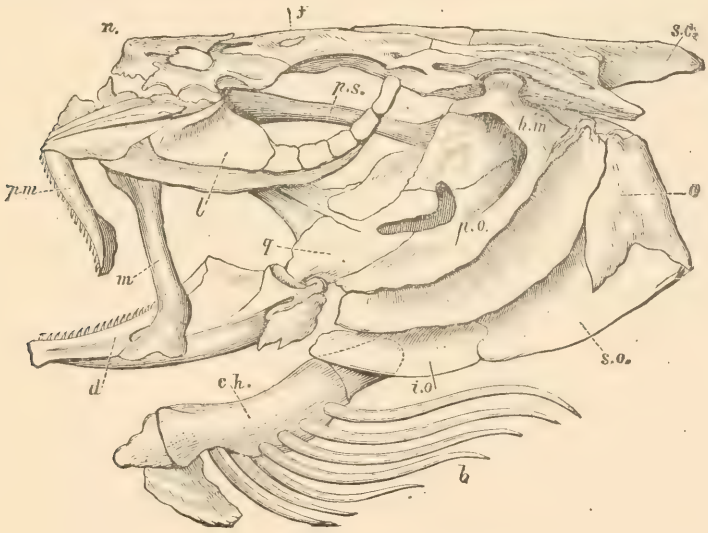


Fig. 3. Skull of the Cod, *Gadus morhua*.

s, o, Supra occipital; *f*, Frontal; *n*, nasal; *p, s*, Para sphenoid; *p, m*, pre-maxillary; *m*, maxillary; *d*, Dentary; *l*, pre-orbital; *q*, Quadrate; *h, m*, Hyo-mandibular; *p, o*, Pre-opercle; *o*, Opercle; *s, o*, Sub-opercle; *i, o*, Inter-opercle; *c, h*, Cerato-hyal; *b*, Branchiostegous rays.

lower or hæmal arch serves to convey blood-vessels, while from it springs inferiorly a hæmal spine.

Between the neural spines and the hæmal spines certain dagger-shaped bones are inserted along the median lines of the body, and which are externally for the purpose of attaching the bases of the dorsal and anal fins. The hindmost caudal vertebra, usually of small size, articulates posteriorly with a fan-shaped bone, the hypural, which along with the last neural and hæmal processes support the caudal fin. Among the plagiostomes the

processes of the vertebræ are more soldered to the bodies, and not so well developed.

The *skull*, or that portion of the skeleton which is situated at the front end of the body articulating posteriorly with the first vertebra, is destined to enclose the brain as well as form the face. It varies much in form in different families of fish, and contains too many component parts to be fully discussed here, but a few remarks are necessary respecting such as more or less enter into the orbits, mouth and respiratory apparatus.

The *suborbital* ring of bones, or those which pass round the lower edge of the eye, consist of several pieces, the anterior of which is generally the largest, and termed the pre-orbital or lachrymal (fig. 3, *l*).

The *mouth* is formed on several plans. At the front edge of the upper jaw in the middle line is a tooth-bearing bone, the premaxillary (fig. 3, *p. m*), also termed the intermaxillary, which is continued backwards in the form of a flat process, which in some forms even extends so far as the middle of the orbit. The premaxillary rests against the toothless maxillary (fig. 3, *m*), with which it is in opposition, and the two move together. There are many modifications of this form of osseous structure of the upper jaw. Thus in the salmon the dental portion of the premaxillaries is comparatively decreased in size, and the maxillary likewise bears teeth.

The lower jaw or mandible consists of two branches or rami, one on either side connected together anteriorly in the middle line by a ligament, this portion being termed the symphysis. Each ramus consists of several pieces, the largest which bears teeth being termed the dentary (fig. 3, *d*), while a small one at the hind end of each is termed the articular and articulates with the quadrate bone (fig. 3, *q*).

The hyoid arch is attached to the temporal bones by two slender styliform ones termed stylo-hyoids; this hyoid arch being composed of a central and two lateral portions. The bones along the two branches commencing from behind forwards are the "epihyal" to which the stylo-hyoids are attached: the ceratohyal to which the branchiostegal rays are attached at their inner end, then two small bones termed basihyals, between which the small glossohyal or os linguis extends forwards to the tongue, while a single bone, the urohyal, passes backwards. This last bone in some fishes extends some way even to the union of the coracoid bones, thus constituting an isthmus, separating the two branchial openings.

The five branchial arches, four of which bear gills (see page xlvii) and one is destitute of them, are externally bounded by the hyoid arch; while inferiorly and along the median line they are attached to a chain of bones, the basibranchials, which are situated above the urohyal and are anteriorly connected with the body of the hyoid. These branchial arches pass upwards, and are attached by ligaments to the under surface of the skull.

The three anterior branchial arches are each composed of four pieces of bone, which commencing from their inferior attachment are known as the hypobranchial, ceratobranchial, the epibranchial. In the fourth arch the epibranchial is wanting, and superiorly the more expanded upper piece which generally bears teeth, is known as the superior pharyngeal bone: while the fifth arch is composed of the cerato-branchial only, and termed the inferior pharyngeal.

The opercular pieces or gill-covers have already been referred to, the most anterior or innermost articulating with the tympano-mandibular arch of the skull. In some fishes as sharks, rays, and cyclostomes, no gill-covers are present, as will be subsequently remarked upon.

The scapular arch which supports the pectoral fin is mostly joined to the occipital bone, and according to Owen and Kitchen Parker, contains the following bones commencing from above: the supra-scapular (post-temporal), articulating with which is the scapular (supra-clavicular), and attached to which is the coracoid (clavicular), while it is united below either by suture or by ligament to the same bone on the opposite side. To this last bone are attached two others, the radius and ulna (coracoid and scapular), and two rows of small bones placed between the forearms and the fin, or the carpals and metacarpals. Attached to the clavicular is a two-jointed bone, the post-clavicular (epicoracoid).

The ventral fins are attached to a pair of triangular dagger-shaped bones, the pubic.

Among the teleosteans there are numerous deviations from the percoid and gadoid forms to which I have principally adverted, many of which will be referred to in the following pages.

Among the elasmobranchs are to be found examples in which the notocord may be observed without any trace of transverse segmentation up to those in which there are distinctly ossified vertebræ. As examples of persistent notocords may be mentioned among the plagiostomes the six-gilled shark (vol. ii, page 308), and the spinous shark (vol. ii, page 323); while among the Holocephala the arctic chimæra (vol. ii, page 286) commences to develop rings in the sheath of the notocord. In the majority of sharks, as the blue shark (vol. ii, page 389), the vertebræ have become completely divided one from another, the individual bones being amphicœlous, and a cavity existing through the centre of the body of each thus permitting an unbroken continuity of the remains of the notocord. In some forms many of the anterior vertebræ coalesce together, while the cranium is more or less in one piece.

Still further modifications occur in the cyclostomes (vol. ii, page 356), wherein the notocord is not segmentated, but neural arches are represented by cartilages along either side of the spinal cord. In the lowest form or Leptocardii (vol. ii, page 366) the type is exceedingly primitive.

MUSCULAR SYSTEM.

The chief masses of muscular structure in this class of animals are seen the great lateral muscles of the body, generally four in number in teleosteans, and which are arranged longitudinally, but divided by oblique tendinous bands (fig. 5) of a gelatinous character (and which dissolve on boiling) into

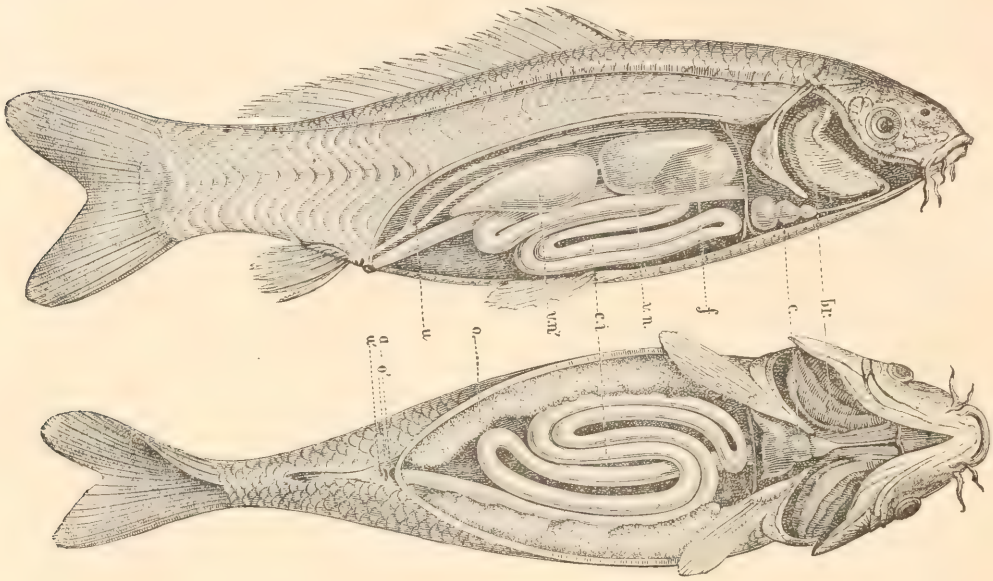


Fig. 4. Internal Organs of Carp.

br, branchiæ or gills; *c*, heart; *f*, liver; *vn*, *vn'*, swimming bladder; *ci*, intestinal tract; *o*, ovaries; *u*, urethra; *a*, vent; *o*, oviduct.

numerous flakes or semi-conical masses termed myocommas. These four longitudinal layers of muscles have the tendinous bands directed much as follows: the upper series passing downwards and backwards, the succeeding layer downwards and forwards, the third downwards and backwards, and the lowest downwards and forwards. These flakes are arched backwards, being convex anteriorly. The number of tendinous intersecting bands correspond with the vertebræ into which they are inserted. The various modifications observed in these muscles, and the systems employed for the movement of the fins, the jaws, eyes, breathing, &c., it is unnecessary to enumerate in this place.

NERVOUS SYSTEM.

This is subject to very great variation, and the brain, which does not fill the cranial cavity in adults, is comparatively small in proportion to that of the general mass of the body.

Does *sleep* or a periodical season of repose for the organs of the senses, ever visit fish, or can it be that balmy slumber is to them unknown, is a question we occasionally see broached. Hybernation during the winter months in cold latitudes, and æstivation during hot months in tropical climates, is generally admitted, but not so simple sleep. Some authors appear to hold to the view that, possessing no eyelids, fish are unable to sufficiently shut out external influences, and cannot therefore be supposed to sleep. Mammals and birds, in short, are sometimes asserted to be the only animals which are periodically visited by refreshing slumbers, while such as are in a lower grade merely rest from time to time in their labours, and withdraw themselves to some quiet nook where they may remain undisturbed. If all fishes sleep it may be asked how do sharks, dolphins, black fishes and pilot fishes follow ships long distances during many days and nights? On the other hand, if not sleeping, what are the basking sharks and sun-fishes about, which permit the fishermen to get so close as to drive harpoons into their bodies before they attempt to get away, or the pike in fresh water that allows a noose to be slipped around its head?

Some years since Mr. Hughes gave an interesting account of how he visited a rock pool at Tenby by candle-light, and noticed several small fishes at the bottom, among them being the active and artful blennies and rocklings. They lay perfectly still, not attempting to dart away to a quiet corner, and permitted the hand to be introduced, when one by one all were caught. These fish seemed either temporarily paralyzed by the light or so sound asleep that their capture was effected with ease.

In rapid waters it has been suggested whether if fish sleep they use their fins in order to keep their position while in a state of somnolence. In the tanks of an aquarium I was able to observe a small "golden tench" lying in a peculiar and apparently uncomfortable position; its tail half was supported by a piece of raised rockwork, while its head was resting on the floor of the tank, and the slightest amount possible of motion only conveyed to the mind of an observer that he was gazing at anything but a dead specimen. The succeeding evening I revisited the tench, and perceived the little golden one as vigorous as its companions, all of which, with a single exception, appeared to be leisurely enjoying their existence, either by feeding or in the contemplation of the varied scenes which were constantly passing in front of their glass enclosure. The solitary exception was reclining on its back and scarcely moved, but on a closer scrutiny its mouth could be seen to open every now and then, and the fish gave a short gasp; the next evening it was swimming about with its fellow-captives and busy wallowing in the soft sand, some of which it took into its mouth and then discharged again, and a third tench was now in a somnolent state.

In another tank in the same Institution wrasses could be seen sleeping in

all sorts of curious positions, mostly at night-time, but likewise occasionally during the day, especially soon after they had taken a meal. These after-dinner naps, as well as such as were indulged in at night-time, appear to be often passed in the same portions of the tank day after day, while the positions assumed by the three-spotted wrasse are by no means less uncomfortable than such as are seen occurring among the tench. Blennies have been observed to occupy the same bed-rooms night after night, while I can only suppose that the little suckers, *Liparis*, sleep during the day-time when they hide themselves in order to be able to move about during the night, which appears to be their period of activity, as they then search for food.

Among the fishes of India which inhabit the fresh waters perhaps the air-breathing snake-headed species gives us the best example of sleeping fish. In the month of December a few years since, while investigating the fisheries of Assam, I was with a party engaged in exploring the Sissera River. We entered a canoe and cautiously ascended the stream. When about three miles from camp all of a sudden our boatmen ceased pulling, and pointed to an object lying in the water under the bank, whispering that it was a large fish fast asleep. We stealthily approached and got within two yards of the spot, when we easily saw a snake-headed morrul, *Ophiocephalus*, about four feet in length, lying perfectly still and apparently fast asleep, just on the surface of a deep pool in the stream. Our repeating carbine was silently passed to our crack shot, he steadily raised it to his shoulder, took a deliberate aim, fired, but we saw the fish no more. Since then I have frequently seen these fishes in an apparently sleeping condition.

THIRST.

Living as these animals do in a watery medium it would appear that the sense of thirst must be unknown, or else that it is quenched by means of endosmosis through the skin. Were this not the case it is difficult to conceive how the salt water forms could satisfy such a longing.

TEGUMENTARY SYSTEM.

The skin or tegumentary system may be entirely or partially scaleless, or should scales be present they may be partially imbedded in the skin, the posterior or external portions of one not overlapping its neighbour, and termed non-imbricated; or they may overlap each other like tiles, when they are termed imbricate. The powers of resistance against external violence is augmented when hard substances enter into its composition, consequently those fishes which are most liable to injury are defended by scales or plates,

which latter may even constitute a dermal skeleton; while it appears to be commonly the case that siluroids are provided with spines for offensive purposes, and fishes with electric organs are scaleless. Scales as a rule have their free edges directed backwards, to prevent their forming any impediment in the water when swimming, and the different forms have been divided into cycloid, ctenoid, ganoid, and placoid.

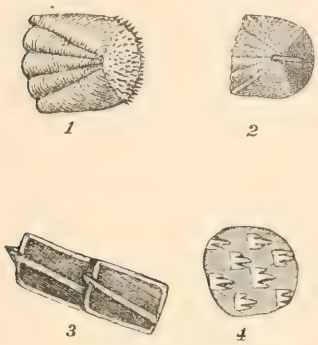


Fig. 5. 1, Ctenoid scale from perch; 2, Cycloid scale from lateral line of gold carp; 3, Ganoid scales from amblypterus; 4, Placoid scales from small-spotted dog-fish.

Scales on their surface may have fine concentric striations, passing parallel with their outer edge, and others more strongly marked radiate from near their centres towards their attached or front border.

Cycloid scales (fig 5, no. 2) are those destitute of any coating of enamel, and with a smooth or non-denticulated free edge. Ctenoid scales (fig. 5, no. 1) differ in possessing denticulations or teeth, often covering a triangular space at their free extremity or being merely restricted to the edge of the scale; these last if spiny, have been termed sparoid scales, while the foregoing forms pass more or less gradually one into the other; both forms may be present on one species of fish. Ganoid scales (fig. 5, no. 3) are furnished with a coating of enamel, mostly of a tessellated form, and often articulated one to another. While placoid scales (fig. 5, no. 4) can be considered as dermal growths or osseous scales, as seen in sturgeons, rays, and some other forms of fish.

Scales of fishes increase in size or grow along with the body of the fish on which they are placed: thus in the salmon or trout the adult has the same number as the young, while they are imbricate to the same extent. The skin consists of the outer layer or epidermis, below which is the true skin, termed dermis or cutis. The epidermis is originally formed by cells, which increase in numbers and constitute an outer and a deeper layer. The cells in the outer layer gradually flatten, and become partially cornified; while the deeper or malpighian layer is in a more active state of existence, new cells are constantly being formed, which push the older ones towards the surface. The cutis or true skin is well supplied with lymphatics and blood vessels, and has a more active vitality than the more superficial epidermis, and it gradually protrudes into slight elevations, which are the rudiments of scales; these increase in size, and passing backwards carry with them their covering of epidermis. At this time calcareous deposits are laid down in the dermis, while the superimposed malpighian stratum on its lower side secretes a hard enamel-like substance. Thus both a portion of the epidermis

and likewise of the dermis enters into the primary elements in the formation of a scale. In some cases in which the scales are large they push through the epidermal layer, becoming partly free, as seen in many ctenoid forms, as perches and sparoids.

TOUCH.

Special organs of touch are developed in fishes in several different manners. Some, as carps, have highly sensitive barbels arranged around their mouths; they are likewise well seen in siluroids or sheat-fishes, which as a rule live in muddy waters, and have mostly to obtain food by means of the delicacy of their power of sensation, while their organs of vision are but little developed (page xxviii). Or these organs may possess more solid bases, but have still a similar function, as in the sub-mandibular or hyoid barbels of the red mullet (plate viii), or the modified maxilla of some sheat-fishes, or even the fin-rays themselves, which for this purpose have occasionally long filamentous terminations, as seen in the John Doree (plate xlviii), or be modified into organs, not only for progression but likewise for sensation, as in the free pectoral rays of gurnards (plates xxii to xxviii). Or these tactile organs may be more essentially cutaneous, as the filaments on the snout of the sole (plate cvi), or perhaps more distinctly visible on the lemon sole (plate cvii); while somewhat similar but larger filaments are found on the bodies of some fish, as the angler (plate xxix). Even papillæ as round the mouths or on the lips are highly sensitive, and as has been shown by Leydig and others they are abundantly supplied with nerves.

The lateral-line* consists of a series of tubes along either side of the bodies of fish (page vii, fig. 1) and is often known as the muciferous system; but although from it mucous is excreted, it is essentially an organ for sensation, and as such is variously modified. It is continued on to the head, where the tubes are largely developed in many families, as the sciænoid and cod-fishes; or may form several canals, as seen in the Arctic chimæra (plate cli). In osseous fishes the inside of the canal of the lateral-line is lined with epithelial cells, often differing in form in different families. Into this canal nerves ramify, and either terminate in an expansion or anastomose with each other, as in Plagiostomes. The simple tubes of Lorenzini are restricted to Plagiostomes, where their presence, due to their black colour, render them so apparent in the skate (vol. ii, p. 337, pl. clxvi), they open at the surface of the skin, do not anastomose one with another, are supplied with nerves, and filled with a thick gelatinous substance, and may be tactile organs.

* Dercum proposes to term it "the lateral sensory apparatus.

COLOURS.

Intimately related to the tegumentary system and the composition of scales is the subject of colour. Among the finny tribes we may perceive external colours of the most varied description, some of which are permanent, many transient, and others again of periodical occurrence. Some of these colours are due to the influence of light, while they may vary in the same species, owing to the character of the water which they inhabit; for should the latter be opaque and muddy, they as a rule are darker than those obtained from localities where it is clear, those in running streams are generally lighter and brighter than when from stagnant pools, or from shallow pieces of water, than from such as are deep, while fish captured in dark caverns are often destitute of both colour and vision.

Age and season likewise exercise an influence in this respect, as do also the state of the health and temporary local emotions. In the very young one sees but few markings or colours, but these rapidly develop themselves, more or less distinctly, by the time, or even before, the first breeding season has been reached, when the brilliancy of the individual has often attained to its maximum. This nuptial adornment is generally acquired a short time prior to the breeding season, subsequent to which it usually disappears. Some see in the colours of these creatures grounds for assuming the probability of the descent of many forms from some common ancestral progenitor; thus vertical bands are almost invariable in the young of the various trout, salmon, and char. However, they are likewise present in many other families, as *Scombresocidæ*, in which they are usually a diagnostic sign of the immaturity of the individual. Large spots or blotches, especially when surrounded by a light margin, are likewise a good reason for suspecting that the individual has not attained its full size. We also see in some forms longitudinal bands modified, two narrow ones taking the place of a single wide one, or they may be broken up into blotches. Some fish which are of a silvery colour in one district are spotted in another, and others which have no marks on their bodies throughout their lives frequently have the colour of their fins varying with age.

Pouchet and others have pointed out that the changeable tegumentary colours of fish depend more especially upon two conditions. *First*, we have iridescence effected by an interference with the rays of light, owing to the presence in the scales of thin plates or ridges, and in these forms the tints change with great rapidity in accordance with the angle at which they are viewed: such lamellar colouring is common among insects, crustacea, and some fishes—it is beautifully seen in the Dolphin, *Coryphæna*, and the scale of a common herring furnishes a good example. *Secondly*, a distinct anatomical element, as chromatophores or colour-sacs, which are often highl

coloured, may be present and capable of changing their form under special influences, which are apparently directly connected with impressions of colour received by the eye and brought about by the reflex action of the nervous system. Under the heading of Pleuronectidæ (vol. ii, p. 1) remarks will be found how these flat-fishes rapidly change their colour on differently coloured bottoms, thus obtaining the protection of concealment by adaptation of colour.

The chromatophores or pigment cells are seen in the early stages of the eggs of fishes, but as observed by Agassiz, in some we have even two colour elements in the older stages, immediately before the young fish is hatched, viz. the black and yellow; still in the majority of cases the black alone is present, the yellow element appearing subsequently, and last of all the red. Pouchet considered the blue pigment merely a dimorphic condition of the red pigment; the same may also be said of the green. And with the growth of the fish the capacity of the chromatophores for expansion rapidly augments.

In addition to the chromatophores another set of bodies termed iridocytes, and more or less analogous to excessively thin laminæ, have been observed situated near the surface. By simple combinations of the action of the red, yellow, and black chromatophores with the iridocytes are obtainable all the colours producible in fish. These result mainly from expansion near the surface, or retraction into an inferior layer of the chromatophores, which thus mixed with the yellow and red, or with the iridocytes at greater or less depth suffice to produce the variations of colour.

These pigment cells are likewise said to involuntarily expand owing to external irritation, as from the muscles of a fish convulsively contracting a short time prior to death, thus accounting for the rapidly changing tints in some which are shown subsequent to the period of capture; and the satiny-red skin of the red mullet is in some places thus produced by fishermen who scale their fish soon after their being captured.

Its appears evident that the influence of light is mostly felt through the eye. Pouchet found that turbots if blinded did not change colour, but those not deprived of sight did: and young hybrid salmonidæ raised at Howietoun in which vision was more or less deficient, were observed to be generally lighter in colour than their fellows, and their fins to become red as they grew older. Whether the degeneration of the eye perceived in cave fishes and those of the deep sea is due to dimness of this organ or an effect of hereditary transmission has yet to be shown. A not infrequent change in some fresh-water forms is a yellow colour taking the place of the original tint: thus the normally dull greenish tench may be seen of a brilliant orange yellow, termed leucœthiopism or xanthochroism. So may likewise the gold carp, although this latter when in a wild state in China is of a dull green. The

temperature of the water, and mixing iron, tan, or gall nuts has also been found to induce this change of colour (see vol. ii, p. 167). The yellow colour is due to incipient albinism, for the chromatophores which normally contain dark ingredients are here filled with yellow pigment, or the first step towards an entire loss of colouring matter when they become albinos.

Dr. Stark observed that if fish are kept in glass vessels of various colours such occasions a tendency to their assuming the colour of the vessel in which they reside, which would aid them in concealment. Mr. Nesbit concluded that light merely modifies an existing pigment which is absent in pink or albino fish, but which it is powerless to manufacture.

The colour of the flesh may be influenced, as in other groups of animals, by the food consumed, minute crustaceans, as gammari are reputed to colour that of the salmonidæ: while white flesh is occasionally the result of insufficient food. Ill-health similarly has an etiolating effect.

LUMINOSITY.

Another subject closely connected with the tegumentary system is the existence of certain metameric organs. There are some pelagic or deep-sea fishes, as *Argyropelecus* (plate cix, fig. 1), *Sternoptyx, Ichthyococcus, Maurolicus, Gonostoma, Chauliodus, Stomias*, &c., which possess luminous organs of a circular form, some being as impressions, others as slight prominences of the skin. A British form exists in the "pearl-sides" of Yarrell, *Maurolicus Pennantii* (plate cix, fig. 2), which is Pennant's *Argentine*. These brilliant spots may be present along the entire length of the abdominal surface or even be seen on the head, but their uses have been subject to much speculation. M'Culloch remarked that, considering at 800 or 1000 feet depth the light of the sun ceases to be transmitted in the ocean, can animal luminousness be a substitute for that light? May it not be the means of enabling its possessor to discover its prey or for its fellows to find one another? Perhaps a partial confirmation of this view exists in the fact that fishes living at great depths or dark places, as in the Mammoth Caves of Kentucky or the recently discovered caverns in Algeria, are found to be destitute of eyes; but they have no luminous organs, while the deep-sea forms which possess them have large eyes. This difference would seem to lend strength to the view that these organs may be for the use of the individuals which are furnished with them, for where no eyes exist these organs are absent.

A few years ago it was advanced that these spots were accessory eyes, possessing a species of lens posterior to the cornea, and a chamber behind the lens containing fluid and having a dark lining, which may serve as a retina: the second form shows a simple glandular structure from which light

may be emitted. In the second form it is evident that this organ could not be employed for vision, being simply glandular, and possibly used to give light, acting as a sort of lantern, the function being probably under the control of the will.

Professor Reinhardt, in 1853, observed on the *Astronethes fieldii*, Val. common in the Atlantic Ocean, between 23 deg. and 6 deg. N. latitude —a fish which possess lenses in these organs. It was only after sunset that he discovered this fish in a drag-net. It is solely at that time that the surface of the ocean begins to be crowded by vast swarms of Pteropoda and numerous crustacea, and *possibly* the fish searches for food among them, following them into greater depths during the day-time. "In two instances I was so fortunate as to catch the fish alive, when I saw that it sent forth two strong and vivid greenish lights, which intermitted momentarily and ceased altogether when the fish died. As the two individuals only lived a few minutes after being taken out of the net, and as the luminous appearance only showed itself distinctly in the dark, it was not until I procured a second specimen, a number of days after the first was obtained, that I ascertained with certainty, that the light radiated from a spot in the forehead, a little before the eyes, starting, as it were, from thence along the back as far as the first dorsal fin: all the rest of the body remained perfectly dark. On examining the whitish speck in the specimen preserved in spirits, from whence the light radiated, a cellular tissue is found underneath, or rather within the skin, consisting of longish cells or meshes, filled with an apparently fatty substance. No doubt this is the source of the phosphoric light, although I have not been able to trace the substance, at least not in an aggregate form, beyond the eyes, so as to account for the extent backwards of the phosphorescence."

There is likewise connected with the question of sight in fishes the subject of the luminosity of other animals residing at great depths, and affording what is known as abyssal light. Along our coasts luminosity of the surface of the sea may be seen during our warm autumn months, among the exhibitors of which are numerous small jelly-like animals more especially the *Noctiluca*. In the account of the voyage of the "Porcupine," Thompson states, that towards the north of Ireland in some places nearly everything brought up seemed to emit light, and the mud itself was full of luminous sparks (p. 98). Star-fishes and the larger invertebrates all exhibited this marvellous property in the Faroes (p. 148). Nordenskiöld found during the polar nights in Spitsbergen in the snow-sledge a number of almost microscopic crustacea giving evidence of their existence by an intense bluish-white light which was emitted as soon as the sledge was touched, causing at every step a bluish-white flame to burst forth.

Few or none who have made voyages to the tropics but must have been

struck with admiration at the luminous radiata and mollusca, while it has been observed that an increase in brilliancy occurs when these animals are in motion. Dr. Guppy has commented upon a small shrimp in the South Atlantic which constantly emits a light from its eyes, while long filamentous organs are likewise to be met with showing apparently a brilliant type of phosphorescence. Among the many curious forms of development of these tactile organs one is seen on a fish found at the depth of 2700 metres in the Mediterranean *Eustomias obscurus*, Vaillant, in which the tactile organ takes the appearance of a long filament, which is placed underneath the lower jaw, and ends in an inflated and rayed knob-like phosphorescent mass. Some marine invertebrates emit a mucous fluid possessing luminous properties which are not immediately lost when mixed with water or other fluids. It is not long since I heard of a gentleman having purchased a lobster, which he took with him wrapped in paper, when going by train from Southampton to his house, which was some hours distant. On arrival his lobster was found to have been kept quite long enough, and having been removed from its paper wrapper was consigned to the cook. Some hours after, on going into the dark room wherein the paper wrapper had been left, he was startled at seeing a dull blue light coming from the table. Cautiously advancing, he gave the uncanny object a poke with a stick, and then found it was the piece of paper which had inclosed the lobster, and doubtless had become covered with its mucous secretion.

Irrespective of this locally-circumscribed luminosity the luminosity of animal substances must be slightly touched upon. General luminosity in fishes may be seen at two distinct periods—(1) during life, (2) after death. The shark is one of the former which has the reputation of being luminous, the light being believed to come from its abdominal surface. Shoals of fish are said to frequently emit flashes of light which are visible even at great depths. The sand-launce in some localities is said to be sought for by moonlight, as at night-time their silvery brilliancy is more striking than it is by day. M'Culloch also enumerates mackerel, pollack, whiting, pilchards, sardines and gar-fish as being sometimes accompanied by these lights. Collett speaking of the *Aphia pellucida* remarks that in the males in full breeding almost every part of the body has a faint brownish light, although this is nowhere collected into larger dots, but is more distinct along the transverse impressions of the muscles. Secondly, we find this general luminosity often exists for some time in dead fish, commencing a short time subsequent to death and continuing until decomposition sets in. In the forms which most rapidly decompose luminosity is most quickly developed. This is well seen in the cod family, and the basket containing these fish kept for feeding the

seals at the Westminster Aquarium might have been frequently observed in a dark corner of the building emitting a very suspicious-looking blue light. This luminous appearance emanates from every part of the animal, whether at the edges of the scales or on its internal surface when cut open, which, if closely examined, is found to emit a slight moisture that can be scraped off, diffused in water, and still remain luminous as observed among invertebrates.

VISION.

Fishes, as a rule, possess two eyes, symmetrically placed one on either side of the head, while they are undoubtedly large as compared with what obtains in other vertebrates, or with the extent of surface in their own bodies. Their size, however, is modified in accordance with local surroundings and their habits. Some frequent muddy waters, where vision would be of less service than tactile organs; in such cases appendages for feeling, as barbels, are more developed than eyes. Others again are restricted to living in dark caves where rays of light can hardly enter. Irrespective of the foregoing cause of atrophy there are many forms residing in the dismal abysses of the ocean where light is unable to penetrate, for solar rays are computed to be lost at a depth of 200 fathoms or less, while in the fresh waters of the Lake of Geneva, Professor Forel ascertained that at 30 fathoms photographic paper was entirely unacted upon. Another modifying influence is whether the habits of the fish are nocturnal or diurnal, the former, unless residing in dark places, requiring the larger organs of vision.

Eyes likewise may be only rudimentally developed, as in the *Amphioxus* or the *Myxine*, wherein they appear as mere dark specks, but still have a nerve distributed to them. Or they may have retrograded to so considerable an extent as to be entirely absent in some forms which have taken up their abodes in dark caverns, but even here the lens and other constituent portions of the eye may usually be detected, whereas examples of the same species living outside are provided with fully-formed eyes. The optic nerve may degenerate, or disuse may occasion degeneration, but loss of light does not necessarily end thus.

The eyes of fishes are mostly situated in orbital cavities, where they rest upon a cushion of adipose or gelatinous substance. Their direction is subject to considerable variation, for although usually placed laterally, as in the perch, salmon, or carp, they are not invariably so. The star-gazer, *Uranoscopus*, has them on the upper surface of its head, where they are situated somewhat close together. Many East Indian siluroids or sheat-fishes, as *Pseudeutropius* or *Ailia*, have them even placed almost underneath and directed obliquely downwards and outwards. The sides of the head may be laterally elongated, having these organs situated at their outer

extremities, as in the hammer-headed shark, *Zygæna malleus*. They may be on elongated peduncles capable of retraction, as in some of the mud-hunting gobies, *Periophthalmus*, *Boleophthalmus*, and their allies, which in tropical countries pursue insects and other objects suitable for food over the soft mud, into which they themselves even disappear when chased by birds or other enemies. While we have instances on our own shores in the blennies, which appear to observe objects as well with their heads out of the water as when submerged in the sea, and they move their eyes independently one of the other. In the sunfishes (*Orthagoriscus*) there exists a circular palpebral fold provided with a sphincter, while some sharks have a nictitating membrane. Among the flat-fishes (*Pleuronectidæ*) are remarkable modifications. In the very young as they emerge from the egg the fry swims on edge similarly to other fishes, but after a longer or shorter period the eyes are both found on the coloured side of the body. These two eyes, even in the adult, can be moved independently of each other. That the eyes in their earliest state are situated similarly to what obtains in the remainder of the class of fishes is very interesting, as tending to show how they have in course of time changed their position—a view still further confirmed when we observe how it is not invariable for the two eyes to be on the right and left side of all members of the same species. (See vol. ii, page 1-4.)

Among the most perfectly constructed eyes in bony fishes the eyeball is rarely quite spherical in shape, but presents the appearance of a flattened bulb and a short axis. Among the semi-osseous forms, as the elasmobranchs, it is supported by, as well as moves upon, a cartilaginous peduncle passing from the walls of the orbit.

The optic nerve may perforate the eyeball in its axis or obliquely to one side; for, should the eye be protrusible to ever so small an extent, it necessarily follows that the optic nerve must either be situated in a position where protrusion of the eyeball would not stretch its delicate structure, or it must be slightly bent or curved, in order to permit extension; compressed as it penetrates the sclerotic and choroid coats, subsequently it expands, ending in the retina which lines about two-thirds of the inner chamber, leaving, however, a margin, where its free borders meet, and through which passes a fold of the choroid, sometimes having a dark pigmental layer. This portion of the choroid, termed the falciform process, pushes before it a fold of the hyaloid membrane or tunic of the vitreous humour. The falciform process generally extends to the capsule of the lens, to which it is firmly attached by a substance termed campanula Halleri.

The outermost covering of the eye, or sclerotic capsule, is of varying thickness, fibrous or bony in osseous, and cartilaginous in semi-osseous or chondropterygian forms, as well as in sturgeons. Owing to the considerable interspace existing between the sclerotic and choroid membranes, and which

is filled up with adipose or areolar tissue, the eye is, as already observed, rarely quite spherical. The sclerotic may even be bony in some well-ossified forms of fishes, the bony portion usually consisting of two hollow half spheres, having a hole posteriorly in the centre, for the entrance of the vessels and nerves proceeding to the eye, while its anterior or outer emargination supports the cornea. In the swordfish *Xiphias*, and in the Dipnoid *Ceratodus*, these two bony half spheres are confluent into one, having the central foramen patent for the entrance of the vessels and nerves.

The cornea, which is as a rule nearly flat, is a modified portion of the corium, in some forms of fishes, at least in their earliest stage, as the shanny *Blennius pholis*, at $1\frac{1}{3}$ inches in length, the protrusion of the cornea equals one-fifth of its diameter, and in a little rock goby (*Gobius paganellus*) at 0·9 inches in length, the convexity to the diameter is as one to four. The choroid tunics are three—the outer, or membrana argentea, said to be occasionally absent, and which is composed of acicular crystals, reflecting a brilliant lustre, and often giving great brilliancy to the outer edge of the iris; the middle tunic, or membrana vasculosa, and also termed Haller's membrane, is ramified with blood-vessels, while it supports the ciliary nerve; the inner tunic, or membrana picta, also termed uvea, is made up of hexagonal and usually dark-coloured pigment cells. The ciliary processes are rarely developed, but the ciliary ligament is always present.

The iris is formed by a prolongation of the choroid membranes, having a ciliary ligament at its base which overlies the convex border of the sclerotic. It is a thin, contractile curtain, situated behind the cornea, and suspended in the aqueous humour. Its muscular structure is but feebly developed in most fishes, consequently its capacity for dilating and contracting is not very great. Its centre is perforated by the pupil for transmission of light to the interior of the eye. This pupil is mostly large and circular, but in some forms is vertically or horizontally elliptical, as in the majority of sharks, or it may even be quadrangular, as in *Galeus*. Occasionally a veil or flap descends from the edge of the iris at the upper portion of the pupil, as may be seen in some pleuronectoids as the turbot, the viper weever fish of our coast, or the more tropical crocodile fish, *Platycephalus*, or in a few rays as the Homelyn (vol. ii, page 324). All these forms live more or less in the sand, or at the bottom of the sea, and to them a large amount of light is evidently unsuited, consequently they are provided with an extensible and retractile veil, which can regulate or entirely obstruct rays entering from above. In the tropical *Anableps* the cornea, or window of the eye, is crossed by an opaque horizontal band, and the iris appears to possess two pupils, a subject I shall again have to advert to. On dissection, however, it is found that in reality the pupil has a lateral flap of the iris on either side, which, although they cross each other, are not conjoined.

The retina is the delicate nerve structure upon which the image of external objects is received. Its posterior or external stratum consists of a cellular base supporting on its external or concave surface a layer of nerve cells, the filaments from which pierce the several superimposed granular layers, the innermost of which consists, as stated by Owen, of interblended twin-fusiform corpuscles . . . each of which is surrounded by a circle of cylindricules. Over this latter the nerve fibres radiate without anastomosing, and terminate in free ends at the base of the ciliary zone. A well-defined raised rim or bead runs along the anterior margin of the retina, and also the edge of the falciform slit.

The aqueous humour in the anterior chamber is very small in amount, owing to the constricted extent of the cavity occasioned by the projection into it of the crystalline lens. But little fluid is necessary to float the free border of the iris, while, due to the watery localities fishes inhabit, no refractive aid is required to be placed anterior to the lens in the globe of the eye. The vitreous body which fills up the greater portion of the cavity of the ball of the eye is of firmer consistence than observed in other vertebrate animals.

The choroid gland is a vascular ganglion of a deep red colour, resembling in form a bent magnet; it is placed between the outer and middle coats of the choroid, and close to the optic nerve where it pierces those structures. It is composed of parallel and closely placed arteries and veins, the supply of arterial blood for which is received from the pseudobranchiæ, and it consequently is wanting in osseous fishes in which pseudobranchiæ are absent, as sheat fish, carps, eels, &c. But in the chondropterygians and ganoids there is no choroid, whereas pseudobranchiæ are present.

The crystaline lens is nearly or quite spherical, very firm, having a dense nucleus, and steadied in its position by the falciform process. It projects into the anterior chamber of the eye which it almost fills, while it nearly pressess against the flat cornea leaving but little room for any aqueous humour. The refractive power of the lens is maximized by its spherical form, to compensate for the deviation from the spherical form of the eyeball produced by the flattening of its front portion. The fibres of the lens converge at its two opposite ends, each having marginal teeth like those seen in a cog-wheel, and by which they interlock with one another. In the *Anableps* previously referred to, a slight bulging or excrescence of the lens occurs opposite to what appears like the lower pupil of the eye. Inhabiting as fish do a watery medium, the need of a lachrymal gland is scarcely obvious; still an instance of its existence in one of these creatures has been recorded. Situated below the anterior corner of the eye is a foramen, through which is a communication with the rudiments of one in the form of a blind sac placed between the maxillary bone and the muscles of the cheek.

In most teleostean or bony fishes, and likewise in the sturgeon or *Acipenser*, a fibrous ligament attaches the sclerotic to the walls of the orbit. As a rule the external muscles of the eyeball are similar to what exist among the higher vertebrates, consisting of four straight and two oblique pairs.

Fishes eyes present a great variety as well as extent of outer coverings, some portions of which are transparent while others are opaque. Skin, in accordance with where it is situated, may have different offices to fulfil, for which purpose it may be necessary to be either opaque or transparent, thick or of a very thin structure, and that which covers the eyes of fishes may be in a single or double layer, either or both of which may be extensively modified. The skin which covers the eye is commonly thin in substance and transparent in character, being modified in order to suit altered conditions as it passes across and covers the front of the ball of the eye, and its glass window known as the cornea, through which all rays of light must necessarily pass to obtain access through the pupil to the retina. This skin is essentially a continuation of that which covers the contiguous parts of the head being reflected from off the walls of the orbit on to the front of the eye, where it is more or less firmly adherent to the cornea. But as it is necessary for the ball of the eye to be capable of being turned in various directions it is obvious that some means must be found to prevent the skin arresting its movements, which it would do were it to pass by the shortest cut from the bony orbital walls to the front of the eye to be there adherent to its surface. This is provided for by its being loose as it passes this gap on to the eye, and being so it does not impede any movements of the globe. This loose or baggy portion which surrounds the eye from the orbital edge to that of the transparent cornea is the portion which after death appears white and opaque, for it is modified skin that takes on this appearance, and often due to its being sodden. The foregoing descriptions briefly refer to such forms as we commonly meet with, and which possess but a single layer of skin across the front of the globe of eye, but in this skin during life no sufficient amount of colouring matter exists to occasion opacity, neither are scales present.

In the next class of fishes to which I shall refer, there still exists but a single layer of skin passing across the front of the globe of the eye, but this is modified, as shown in the mackerel, *Scomber scomber*, wherein what have been termed "adipose lids" are present on either side of the eye, and covering a portion of its ball. If these adipose lids are examined it is found that the one which covers the anterior portion of the eye is attached inferiorly to or is a continuation of the skin on the front of the preorbital bone, and is consequently situated anterior to or overlapping the base of the posterior lid, which is attached to the posterior edge of the preorbital. The use of this will be readily understood, because in this manner any current of water would pass backwards over a smooth surface, which would not be

the case were the posterior lid overlapping the anterior one. These adipose lids are formed by a single layer of skin having been continued from the contiguous parts of the head, over the front of the eye, but bulging anteriorly and posteriorly; these bulging or loose portions become a double fold, between the layers of which fat may be found. Sars, who paid particular attention to the character of these lids, as seen in the living fish, remarked that in the earlier part of the year off Norway they are much more opaque than they are later on, due to the fish in these earlier months being fatter, and that it is not until after they have spawned that the fat becomes absorbed, and as a consequence the lids are transparent.

There are also certain classes wherein a double layer of the skin may partially or entirely cross the front surface of the eye, among which I propose to allude to the well-known "blind" or "bib," *Gadus luscus*. In this fish, belonging to the cod family, the orbital layer of skin may be popularly described as splitting into two layers, the innermost passing on to the eye and becoming attached to its front surface, as I have already described; but, due to the skin being in two layers, a sort of hollow bag is present, covering the front of the eye, and this the fish appears to be able to distend under certain conditions. One of these conditions is on its being drawn up from great depths in the sea, at which time (due to the decreased pressure of the water) its gases expand and this cavity becomes "baloon-shaped," or, should fluid be inside it, like a "bleb" or blister. The same appearance now sets in as described in the loose and baggy portion of the single layer around the globe of the eye, with this addition that in the "bib" the entire structure of the bag in front of the eye becomes of an opaque or white sodden character, and this may be seen either in the living fish or after its death. The mangoe-fish and other *Polynemi* of the tropical seas have a thick layer of transparent skin passing entirely across the eye, while in the common mullet (*Mugil*) a vertical and elliptical opening is present.

Not only have we a transparent skin covering the eye as described, but also we may have it only partially thus modified, or largely covered with opaque substances. Thus in the snipe-fish, *Centriscus*, which has been captured on the British coast, some minute scales are present on the outer fourth of the skin covering the globe of the eye, except in its anterior portion; here they would mostly serve for protection from direct injuries. Some forms have a species of almost fixed eyelid along the upper portion of the eye, consisting of thickened and coloured skin, which may or may not be furnished with rudimentary scales. This is commonly perceived in such as reside on or near the sand, and are mostly bottom-feeders, and is very probably protective; in these forms of fish the iris or pupil is sometimes unlike the round or oval shape which is generally seen. As an example, the

weever or sting-fish, *Trachinus*, has this modification of the upper eyelid, and so also has the tropical crocodile-fish, *Platycephalus*, in the last of which, however, very rudimentary scales are also perceived, and the iris has two tongue-like excrescences.

This opaque upper lid, evidently used as a protection, is found in the flat-fishes, *Pleuronectidæ*, while another modification may likewise be present. If the eye of a turbot, *Rhombus maximus*, is examined it will be seen that not only does thick opaque and coloured skin cover its upper and lateral portions, but, being insufficient to protect the eye from the irritation of the sand wherewith it covers itself, it is able to raise a thick lower eyelid, or else to depress the transparent portion of the globe of the eye below this fold of the skin. In the sun-fish, *Orthagoriscus*, as previously observed, we find a circular palpebral fold, provided with a sphincter muscle.

Passing on to the rays and skates, which are sand-loving forms, we still see immovable and opaque skin covering the upper portion of the eyeball; but, irrespective of this protective modification, there are other means which can be used in order to prevent too much light obtaining entrance through the pupil. This is effected by certain veils or processes, of different forms, which can be employed to cut off any excess of light. I have already alluded to the teleostean crocodile-fish, *Platycephalus*, which lives in the tropics, and resides at considerable depths, but often has to ascend to near the surface in order to obtain its food. Here we find two processes of the iris which can be employed as curtains—the upper and larger exists along the upper margin of the pupil, and the smaller along the lower. So far as I have observed, it is in these ground-feeders which occasionally ascend towards the surface, from a dull into a bright light, that the upper veil or flap of the iris is developed, while in some a lower veil may likewise co-exist. The same modification is perceived in many of the Elasmobranchs; thus in the homelyn-ray, *Raia maculata*, we see on looking through the transparent cornea that the pupil is not circular, but possesses a veil that has been aptly compared to a vine-leaf (vol. ii, p. 334), provided with twelve digitations, that can be let down and thus cut off some or all the rays of light. Muscular fibres, which anastomose with each other, pass downwards along this flap, and into each of the digitations which descend from it.

The lens itself may likewise be modified, as in the *Anableps*, the eye of which is divided externally into two unequal portions by a sort of band of opaque skin, which crosses its transparent cornea from one side to the other. This fish, which usually swims with its head partially out of the water, thus shows an anomaly that at first seems very puzzling, for why should it be furnished with an opaque band precluding any rays of light entering the orbit along a central horizontal line? On looking through the cornea it appears as if this opaque band divided two pupils, preventing any rays

passing into the space between which these two pupils are impervious, and where they might stimulate the iris. But on removing the cornea it is seen that, as already described, two lateral flaps of the iris appear like two small tongues, which start one from the anterior border of the circle of the pupil, and the other from its posterior border; the two approach each other and touch or even overlap, and here the one lies over the other. These tongues overlapping, it follows that the circular pupil is subdivided into two openings, the upper of which is the larger. It is across where the two tongues overlap one another that the opaque band of skin crosses the cornea. The crystalline lens is placed behind this singularly subdivided pupil, and is not perfectly round, as seen in the lenses of most fishes, but a little convex projection bulges out on its lower edge, which corresponds to the inferior orifice of the pupil. It would seem as if this fish, possessing a sort of double eye, has to keep a watch on the waters below through the lower pupil, and in the air above through the upper; while the band of skin which crosses the eye does so where the head of the fish is on a level with the upper edge of the water.

Doubtless the foregoing account of fishes' eyes might be largely increased, and many more illustrations given did space permit, but the foregoing are sufficient for the purpose of pointing out that the skin of fishes' eyes may be used as a protection, when it is scaled, coloured, or even transparent.

TASTE.

The sense of taste in fishes is generally considered to be but slightly developed, a conclusion to a great extent arrived at because most fish bolt their food, and but few have molar-formed teeth capable of mastication. On the other hand, the angler, line-fisherman, and pisciculturist perceive that they will ravenously devour one kind of food, rejecting another, that they have their likes and dislikes, which must have some connection with the density of the object or else with its taste.

The glosso-hyal bone does not as a rule support a tongue or organization of soft parts specially devoted to the development of the special sense of taste; as, when present, it is not infrequently found to be furnished with teeth, and deficient of the muscles and soft parts so conspicuous in the tongues of the higher vertebrates. In the sturgeon, irrespective of papillæ for taste on the tongue, branches from the glosso-pharyngeal nerve have been traced to the branchial arches and palate where possibly the sense of taste resides. In carps on the roof of the palate is a thick, soft, vascular, and highly sensitive mass, which becomes thinner anteriorly while it is

supplied by branches from the glosso-pharyngeal nerves. Schulze (1862 and 1867) assigned to the cyathiform corpuscles of fishes, functions identical with those of the gustatory bodies of the mammalian tongue. Jourdan (Comptes Rendus, 1881, p. 743) confirmed the foregoing, and in gurnards found these bodies upon the tongue, and suggested they might be present in the buccal mucous membrane of most fishes. Also that among the nervous terminations, described by M. Joubert as organs of touch, we must distinguish those which possess cyathiform bodies from those which are destitute of them, and that these bodies are gustatory papillæ.

SMELL.

That fishes possess the sense of smell has long been known, and in olden times anglers employed certain essential oils to add zest to their baits. Some years since when at Roorkee, in Upper India, I was told of some fine barbels, Mahaseer, attempts to tempt which with bait had proved ineffectual, when a native suggested adding a little camphor, subsequent to which no difficulty was experienced in obtaining a bite. A pike in clear water has been seen to approach and then turn away from a stale gudgeon, and this may have been due to smell.

Eyeless forms or those blind must depend on the sense of smell as well as of that of touch. Some fish, due to accident, disease, hereditary malformation or want of development, are found totally devoid of vision, yet to be in good condition and well-nourished, are daily taken by fishermen, and the question forces itself on us how did they obtain food if belonging to forms not furnished with barbels. Sir H. Davy considered it probable that trout might have similar relations to the water it breathes that an animal with delicate nasal organs has to the air, and fancied that there might be nerves in the gills, which afforded it this sense of the qualities of the surrounding fluid.

Fish are provided with organs of smell to enable them to receive impressions from the surrounding medium, directing them to their food or warning them against impurities in the water. These organs are situated much as we perceive them in the higher animals, but, exceping in Cyclostomata, with this essential difference, that they do not communicate with the mouth, nor are they related to the function of breathing, for were their delicate lining membrane subject to incessant contact with currents of water, such would doubtless have a deteriorating effect, owing to the density of the respired element. The nostrils are essentially depressions or cavities, lined with a large extent of a highly vascular pituitary membrane, packed into as small a compass as possible, while we generally perceive one or two external openings situated on the anterior portion of the snout. The capsule which lines these

depressions is formed of a fibrous membrane, which in its turn lies upon a cartilaginous or more frequently an osseous basis, termed the turbinal bones.

The appearance of these openings or nostrils in bony or teleostean fishes is various. There are generally two apertures on the upper surface, side, or front edge of the snout leading to each olfactory sac, the one often tubular, the other oval and patulous, while between them a bridge of integument or even a wide interspace exists, and attached to their edge is often a valve which protects one or both of the orifices. The anterior nostril is most frequently tubular and contractile, the posterior open, while internally the two communicate one with the other. In a few forms only one opening is present for each sac. In some eels and a few other bony fishes we find a nasal orifice on the inner side of the upper lip.

In the Plagiostomes the nasal depressions are very large, and a membranous or cartilaginous opercle is present, by which they may be closed: they open on the under surface of the face. The membrane lining them is exceedingly vascular, and provided with crypts which secrete mucus; the membrane is sometimes folded, and on these folds are occasionally stellated ridges, in order to increase the extent of the surface. As the nasal cartilages have their proper muscles, it has been concluded "that these fishes scent as well as smell, *i.e.* actively search for odoriferous impressions by rapidly changing the current of water through the olfactory sac" (Owen, i, p. 329).

In the Cyclostomata we find an unpaired or single nasal aperture, situated on the upper surface of the head. In one species, "the Myxine," a communication with the palate exists in the form of a naso-palatine canal, which opens backwards on the palate, where it is furnished with a valve; whereas in the *Petromyzon* the nasal duct terminates in a blind pouch, without perforating the palate. In *Amphioxus* the organ of smell is likewise single, in the form of a simple depression, placed rather on the left side, and which ends in a small, dilated, blind pouch, resting upon the central axis of the nervous system.

For the supply of these organs we have the olfactory nerve, which arises alone from the rudimentary hemisphere of the brain, and having dilated, perforates the anterior portion of the skull, where it corresponds with the cribriform plate of the ethmoid bone, and immediately divides and subdivides upon the radiating laminæ here covered with the pituitary nasal membrane. A branch of the fifth pair or one for sensation likewise goes as an accessory nerve to the organs of smell.

That odour may exist in water is evident, and I have been informed by a gentleman who kept tame otters in India, that he has seen them hunt along the bottom of a narrow and clear stream, following the trail of a fish as unerringly as a hound works on land. Whether this odour is from the fish itself or due to its excretions may be questioned.

HEARING.

Hearing is developed in all fishes (except perhaps in the Amphioxus), and it is very remarkable how any diversity of opinion can exist as to their possessing this sense. Mr. Bradley instances how at Rotterdam, seeing some carps fed which were kept in a moat of considerable extent, and having kept quiet some time in order to be convinced that the fish would not come spontaneously, the owner called in the manner he usually did at feeding time, when they immediately gathered from all parts of the moat in such numbers that there was hardly room for them to lie by one another. The same gentleman alludes to a pond full of tame pike at Sir J. Bowyer's, near Uxbridge, which could be called together at pleasure. Lacépède relates how some fish, which had been kept in the basin of the Tuileries for upwards of a century, would come when they were called by their names; while in many parts of Germany, trout, carp, and tench were summoned to their food by the ringing of a bell. At many temples in India fishes are called to receive food by means of ringing bells or by musical sounds. Lieutenant Conolly remarks upon seeing numerous fishes coming to the ghaut at Sidhnath to be fed when called. Carew, in Cornwall, is said to have called his grey mullet together by making a noise like chopping with a cleaver, and Sir Joseph Banks collected his fish by means of sounding a bell. Mr. Dunn remarks that he has known pilchards start out of the water by tens of thousands on the Plymouth nine o'clock gun being fired, fully thirty miles away.

Irrespective of the fact of hearing comes the inquiry, why, if fish cannot hear, do they possess a complicated internal auditory apparatus? It is generally asserted that in this class of animals there exists no vestige of an external ear, but an auditory canal has been observed in some of the Chondropterygians, as rays, opening on the surface of the head, near the spiracle in dog-fishes, but in sharks it is generally covered by the skin.

The internal auditory apparatus of fishes are, as a rule, placed outside the cavity which contains the brain, as seen in sharks, or more or less within the cranial cavity, as in teleosteans. Its chief constituent parts are the labyrinth, which is composed of three semi-circular canals and a vestibule, which latter expands into one or more sacs, where the ear-bones or otoliths are lodged. A tympanum and tympanic cavity are absent.

Many teleostean fishes possess fontanelles between the bones forming the roof of the skull, and which, being closed by very thin bone or skin, sounds from the surrounding water may be readily transmitted to the contiguous internal ear. But the chief mode in which hearing exists must be due to the surface of the fish being affected by vibrations of the water,

caused by sounds transmitted directly to the internal ear, or else by means of the air-bladder acting as a sounding-board (see page xliii).

Prior to observing upon the air-bladder arises the question, whether fish can or cannot communicate by means of sound one with another. Mr. Symonds tells us how, introducing a brass minnow as a bait he killed a large number of perch in four days in a certain piece of water, but that subsequently they entirely refused this bait, although, on the pond being drained, thousands of these fish were found to be present. Also that he has seen the same result follow in another piece of water, whereas in neither could one in a hundred fish have been pricked by the hook.

VOICE.

Voluntary and involuntary sounds, due to emotions, are emitted in different manners by many fishes, and in some rare instances solely at certain seasons. Very dissimilar organs may originate somewhat similar sounds, while sounds apparently identical may not always be expressive of the same feeling. But as the human voice can be modified into tones of command, love, terror, &c., so in fishes one sound may denote fear, danger, or anger, and perhaps even terms of conjugal endearment.

M. Dufossé conducted with great care experiments on these subjects upon some of the fishes of the Mediterranean, and reduced his results to a system, in which the various sounds and modes of their production are most elaborately classified. Thus some occur on their being removed from hooks and thrown into a bucket; these may be temporary and mostly involuntary, and often convulsive and unintentional: their production may be due to unusual movements of the jaws, opercles, or other bony elements; or else induced in thick-lipped forms, as the tench and carp, when compelled to suddenly open their mouths; the tench repeats the noise from its lips so frequently that it has been compared to the croaking of a frog.

There are voluntary sounds as constant ones always produced by the same organ which are evidently intentional, and can even serve to characterize a species. Thus we find expressive sounds as of a harsh grating nature, as stridulation caused by the friction of the dental organ, or of some bones as the pharyngeals which guard the entrance into the gullet, or the densely hard prominences of the jaws as observed in the sun-fish. Musical sounds may be occasioned by the contraction of muscles which are contiguous to the air-bladder, or are attached to the air-bladder itself as in the "mailed gurnard."

Many fishes when captured emit sounds which appear to be due to terror, as a scad or horse-mackerel (*Caranx hippos*), a globe-fish (*Tetrodon*), and others grunt like a pig. A Siluroid found in the Rio Parana, and called the

Armado, is remarkable for a harsh grating noise which it emits when caught by hook and line: this can be distinctly heard while it is still beneath the water. The cuckoo-gurnard (*Trigla pini*) and the maigre (*Sciæna aquila*) utter sounds, not only while being removed from the water, but the latter likewise, when swimming in shoals, emits grunting or purring noises that may be heard from a depth of 20 fathoms. The *Corvina nigra*, a fish in the Tagus, emits sounds resembling the vibrations of a deep-toned bell, gong, or pedal-pipe of an organ. Herrings (*Clupea harengus*), when the net has been drawn over them, have been observed to do the same. The fresh-water bullhead (*Cottus gobio*) emits similar sounds. At Madras I obtained several live sheat-fishes, *Macrones vittatus*, locally termed "fiddler fish," and on touching one which was lying on some wet grass, it erected its armed spines, emitting a sound resembling the buzzing of a bee, and apparently in anger or fear. Canon Tristram when in Palestine obtained some amphibious siluroid fish, *Clarias macracanthus*, which on being taken in the hand "squealed and shrieked with a hissing sound like a cat at bay, and rapidly floundered back to the streamlet, working their way rapidly among grass and over gravel."

AIR-BLADDER.

Prior to noticing the functions of respiration, some remarks will be necessary on the air-bladders of fishes, also termed the swim-bladder, and the air-sac or air-vessel (fig. 4, page xviii, *vn*, *vn'*). It is a single or variously sub-divided sac, or it may be two sacs, partially or completely separated one from the other. Situated above the centre of gravity,* it lies beneath the vertebral column or backbone, from which it is more or less divided by the kidneys, while inferiorly the peritoneum is between it and the intestines. As this organ is entirely absent, or ceases to be developed in many fishes, and may be present or wanting in species belonging to the same genus, it would appear that it is not indispensable to the existence of these animals, its functions being under certain conditions accessory or supplemental, to those of other organs of the body; while it is generally observed that the urinary bladder is largest in those forms where the air-bladder is absent. In the embryo it originates as a bud or offshoot from the upper portion of the alimentary canal, or even from the stomach; this offshoot next elongates into a blind tube, which enlarges at its terminal extremity into what will eventually form the air-bladder. Consequently at some period of a fish's existence there must of necessity be a tube connecting the air-bladder (should one exist)

* Were the air-bladder below the centre of gravity, or its contents evacuated into the abdominal cavity, the fish (unless its fins were very greatly developed) would roll over on its back, as we see occurs in *Tetrodons* and *Diodons*, when they inflate their œsophageal sac.

with the alimentary canal, into which latter it opens usually on its superior or dorsal, rarely on its lateral, but occasionally on its inferior or ventral wall.

The air-bladder is present in the sub-classes DIPNOIDS, all the members of which are fresh-water; also in the GANOIDS, which are entirely or partially fresh-water fishes. It is absent in the CHONDROPTERYGII, except in a rudimentary form, as a diverticulum opening on the dorsal wall of the pharynx, and then only in some genera. While in the lowly developed CYCLOSTOMATA (*Marsipobranchii*) and the LEPTOCARDII (*Pharyngobranchii*) it is entirely wanting.

In the large sub-class *Teleostei* it is present in the Orders *Acanthopterygii*, *Lophobranchii*, and *Plectognathi* as a closed sac (*Physoclisti*), the majority of these fishes are marine. Whereas in the *Physostomi* it generally exists as a sac, having a connecting tube opening from it into the alimentary canal; the largest proportion of which fishes live in fresh water. As a general rule the air-bladder exists more constantly in the fresh-water than in the marine classes.

Among the DIPNOIDS it is distinctly or indistinctly double, lung-like, and communicating throughout life, by means of a duct and glottis, with the œsophagus or pharynx. It is thus in the *Lepidosiren* of the Brazils, in South America; *Protopterus* of tropical Africa; and *Ceratodus* of Queensland, South Australia. All these fishes have been observed to ascend to the surface of the water for the purposes of respiration, and take in atmosheric air direct; a mode of breathing, however, not confined solely to these forms.*

The *Acipenser* or sturgeon is provided with an air-bladder, but not similarly cellular to those already remarked upon; it does not appear to be employed in respiration, but its functions seem to be restricted to acting as a float. The opening from the air-bladder into the alimentary canal is that of a lower type, being on the dorsal surface, and it is not guarded by a glottis.

Thus among the Dipnoids the air-bladder has a lung-like function, opening on the ventral wall of the pharynx, and protected by a glottis. But among the Ganoids there is a divergence from the Dipnoid organization. Although *Amia* has a respiratory air-sac, opening into the pharynx by a glottis, the communicating orifice is on the upper or dorsal, and not on the lower or ventral aspect, as occurring in the higher forms. *Polypterus* it is true opens on the ventral wall, but in *Acipenser* the respiratory function has not been developed, and the pneumatic opening is upon the dorsal wall of the pharynx.

Air-bladders in fishes as might be expected in organs appearing in the lowest class of vertebrates, are of diverse forms and sizes, as well as differently protected. Existing in the abdominal cavity, as already described,

* See Day, Cotteswold Naturalists' Field Club, vol. vi, pp. 229-242.

they have usually two coats—an external, fibrous, tough, and glistening, and an internal, vascular, and mucous one. Between these two coats is often seen (especially in the Physoclisti) a red glandular body, most frequently in its inferior region, and compared by some anatomists to the thymus. This gland seems to have the character of a rete mirabile, consisting of a double plexus of arteries and veins.

It has long been known that the gas contained in the air-bladder is a mixture of oxygen, azote, and carbonic acid, in variable proportions, in accordance with species, and even with individuals. M. Moreau has proved that among the fishes in which the air-bladder is closed (*Physoclisti*) this organ always contains a greater part of the oxygen whenever the animal is in a normal condition, that the oxygen disappears little by little if the animal cannot any longer derive it from its surroundings, and that finally it perishes asphyxiated.

The air-bladder, excluding those forms which respire air, is generally found after death tightly distended with gas, and this consists chiefly of nitrogen in the fresh-water forms, and oxygen in marine genera, this latter substance augmenting in sea fishes in accordance with the depth at which the fish is captured. It has formed a subject of considerable discussion as to how this gas is generated, but, as in those classes in which the air-bladder is a closed sac (*Physoclisti*), it is as well seen as in others possessing a pneumatic tube (*Physostomi*), one cannot resist believing that the gas must be eliminated from the blood-vessels lining the interior of the organ. Probably the gland serves the special purpose of removing superfluous gas or any deleterious substance, while the pneumatic tube is not employed to admit the ingress of air, but acts as safety-valve when the organ is too tightly distended.

The air-bladder is homologous with the lung in its position and function in some of the higher orders; and as a gradation can be traced, it becomes no less clear that this homology (whatever its functions may be) exists throughout every variety and condition of air-bladder in the piscine tribes. The arteries which supply the air-bladder in teleosteans are offshoots direct from the abdominal aorta, cœliac artery, or last branchial vein; the blood is returned to the portal, hepatic, or great cardiac vein. In the highest class of fishes we find this organ differently supplied, as it is not only the homologue but likewise the analogue of the lung, thus in Lepidosiren* venous blood is distributed to the organ and arterial conveyed away, the two efferent veins having coalesced, pierce the large post-caval, then pass forwards and through the sinus and auricle, and thus discharge the blood into the ventricle. Consequently we find that in this organ there are two distinct modes of

* Quekett, who injected a small portion of the air-bladder of this fish, found the arrangement of the vessels was precisely similar to that existing in the lungs of reptiles.

sanguification, in the lower division arterial blood goes to it and venous is returned from it; whereas in the higher forms venous is carried to it, oxygenated at it, and returned as arterial blood into the heart.

In teleostean fishes the air-bladder exists in the form of a closed sac (*Physoclisti*), as in the spiny-rayed *Acanthopterygians*, the spineless *Anacanthini*, the tufted-gilled *Lophobranchii*, and the hard-jawed *Plectognathi*. While in the remaining orders a connecting duct remains pervious, as in the *Physostomi*, excluding the family *Scombresocidæ*.

The air-bladder, however, is not only absent in many families, but it may be present or deficient among species of the same genus. One form of British mackerel, *Scomber colias*, possesses this organ, while the *S. scomber* has none. This is by no means peculiar to European genera.

In such forms as swim near the surface the air-bladder is generally of a comparatively small size; while in those which live near the bottom, as the flat fishes, *Pleuronectidæ*, it is as a rule absent. In species possessing this organ, should it become ruptured from any cause, permitting the contained gas to escape, the fish has by some authors been observed to sink to the bottom, and to be unable to re-ascend, a conclusion some experiments have failed to establish. On the other hand some forms which have been hooked or netted at great depths and suddenly brought to the surface, without having time to compress or partially empty their air-bladders, the contained gas being no longer weighted down by a mass of superimposed water, expands rapidly, causing the organ to burst, or else forcing the stomach and upper portion of the alimentary canal into the fishes mouth.*

The chief use of this organ (excluding respiration and the production of sound) in teleostean fishes are two—(1) A *hydrostatic*, or for flotation, which serves by contracting or distending its capacity, to condense or rarify the contained gases, giving it the mechanical function of enabling its possessor to maintain a desired level in the water, and which is accompanied with the power of renewing, expelling, and compressing, or dilating its gaseous contents, so that it can rise or fall as necessity occurs. (2) The second use is *acoustic*, it being partially or entirely employed for hearing, by means of various modes of connection with the internal ear, mostly by tubular prolongations of the air-bladder, or a connecting chain of auditory ossicles.

Among the *Physoclisti*, the majority of which are marine, we find the air-bladder as a closed sac, having a single cavity, as observed in many of the Percidæ, wherein its greatest length is in its longitudinal axis. In some forms, as "*Holocentrum* and *Sargus* cœcal processes of the air-bladder diverge to attach themselves to the membrane, closing the part of the

* "A fish may remain at the bottom of the water due to the very fact of the pressure of the column of water on the air contained in the bladder."—MÜLLER.

octocrane containing the sac of the great otolite" (OWEN). It has likewise been remarked that in the scad or horse-mackerel, *Caranx trachurus*, a canal passes from the air-bladder to the bronchial cavity, permitting the escape of air, although it does not serve to admit it.* KNER † observed that in several fishes provided with pectoral pores, the thymus gland is absent, and the air-bladder communicates with the œsophagus by an open duct in some Acanthopterygians, as *Holocentrum*, *Priacanthus*, *Cœsio*, &c. The air-bladder may have lateral attachments, as in *Sciæna*, or blind appendages, as in *Polynemus*. The interior of the air-bladder of Physoclisti, as the cod, is lined with a thin membrane of silvery whiteness, composed of a series of fibres, covered with a basement membrane, provided with scales of epithelium; beneath this is a layer of vessels, while inside is situated a highly vascular body, receiving blood direct from the aorta: capillaries exist, and here veins commence. In the perch the glandular body is not in one compact mass, but scattered about its interior.‡

If we examine the *Physostomi*, or those families in which a pervious pneumatic duct exists throughout life, we find the majority of such are fresh-water forms,§ situated between the Physoclisti on one hand and the Dipnoids and Ganoids on the other. This pneumatic tube possesses the same coats as the air-bladder, is of various lengths, and is said to be occasionally tortuous. As a rule it opens upon the dorsal surface of the alimentary canal, but in some of the herring family directly into the stomach. The glandular body observed upon as existing inside the air-bladders of the Physoclisti, is not so well developed, as a rule ‖ in the Physostomi. As this pneumatic tube has no muscular coat its diameter can hardly vary, except when acted upon by other forces, it would therefore be useless for inspiration. If we examine a carp we find its air-bladder is generally a simple sac, with a constriction between its anterior third and posterior two-thirds, but not sufficient to close the communication. From the posterior portion of the air-bladder¶ springs the pneumatic tube, as already described; or else this organ may be in the form of two rounded portions placed side by side beneath the bodies of some of the anterior vertebræ, and not communicating with each other; but the two pneumatic

* A. MOREAU, Compt. Rend., lxxx, pp. 1247-1250.

† Sitz. Ak. Wiss. Wien. 1864, xlix, May, pp. 455-459.

‡ QUEKETT, Trans. Microp. Soc., i, 1844, p. 100.

§ The majority of marine Physostomi are littoral, or surface swimmers, often weak forms, which have to escape pursuit of enemies while rapidly rising to the surface.

‖ In the eel there are two, placed one on each side of the duct communicating between its two portions: the distribution of its vessels in the upper compartment of its air-bladder QUEKETT likened to the cellular lung of reptiles.

¶ In carps the anterior portion of the air-bladder is very elastic, the posterior but slightly so. MÜLLER observed that "in proportion as the fish rises in the water the anterior bladder, which is the most elastic, must considerably increase in volume, and thus keep the head of the animal up, while the contrary must be the case when the fish descends."

tubes coalesce previous to entering the dorsal wall of the alimentary canal. Not only in the *Cyprinidæ* but also in the *Characinidæ* and *Siluridæ* a chain of auditory ossicles connects the air-bladder with the internal ear, instead of a tube filled with gas, as remarked upon in the Physoclisti. Three ossicles on either side pass forwards along the under surface of the body of the first vertebra, connecting the outer wall of the air-bladder with the atria of the vestibule. These ossicles were first pointed out by WEBER; and since his time it has been shown that they belong, like the capsules of the special organs of sense, to the splanchnoskeleton.

In the same family, or that of carps, we find a curious form of loach, *Botia*, in the East Indies, that can scarcely be said to be entirely a ground-feeder, but seems intermediate in habits between the true carps and the grovelling loaches. It has the anterior portion of its air-bladder, or what may be termed the acoustic part, more or less enclosed in bone, this being formed from the parapophyses of some of the anterior cervical vertebræ. All fish with the air-vessel enclosed in bone are bottom feeders, and very few are destitute of barbels. In the true ground-feeding loaches, as the *Nemacheilus* and *Cobitis*, it almost appears as if the posterior two-thirds of the air-bladder, or its hydrostatic portion, were deficient; the organ being in the form of two round lobes, placed side by side, below the bodies of some of the anterior vertebræ, where they are almost entirely enclosed in bone. The pneumatic tube, however, is still found to exist. In another exclusively ground-feeding form of carp, *Homaloptera*, in the East Indies, and in which the lower surface of its body appears flat, and its general conformation refers to its habit of clinging close to stones at the bottom of streams, we find the air-bladder entirely wanting.

Another fresh-water family of Physostomi, the *Characinidæ*, residents of tropical Africa and America, are exceedingly interesting, as regards how this organ is modified in respect to hearing; a chain of auditory ossicles extending from it to the internal ear, as observed in the Cyprinidæ. While in *Erythrinus* we perceive a most interesting link between the Physostomous Teleosteans on one hand and the air-breathing Ganoids on the other, for in this genus, although the air-bladder is above the alimentary canal, the pneumatic tube pierces the left side of the throat. The air-bladder is likewise sub-divided by fibrous partitions, but whether such are exceedingly vascular or not, whether this organ is used for respiration or simply for flotation, there does not appear at present to be evidence upon which to decide.

The extensive fresh-water Physostomous family (which has likewise some marine representatives) of *Siluridæ*, or sheat-fishes, is very abundant in the tropics. Among them the air-bladder is remarkably modified, in the majority of instances being apparently more useful for auditory that for

hydrostatic functions, and as a general rule being smaller in fresh-water than in marine species. The *Siluridæ* of Asia live the life of ground-feeders, and the power of employing their air-bladder as a float appears to be subservient to that of hearing. In the marine forms it has thickened walls, and the parapophyses of the first vertebræ (ex. *Arius subrostratus*) form expanded plates, to the under surface of which this organ is attached. As we go inland, especially towards the Himalayas, this organ becomes more and more enveloped in bone until it is as we find it in the loaches, while, like the Cyprinidæ, a chain of ossicles passes forwards to the internal ear. In the marine forms the broad plate on its upper surface and bony stays to its partitions would appear to exist for the purpose of counteracting superincumbent pressure; while in the fresh-water forms this bony covering, being greatly increased, would seem to be due to some fresh-water physical cause, not to a tropical climate, as I have observed the same phenomena is seen in European loaches. As all are ground-feeders, one reason at least must be to prevent undue pressure on that organ when at great depths, and to preclude any abnormal interference with the function of hearing.

Among the marine Physostomous forms all that have been examined, I believe, and in which communications exist between the air-bladder and internal ear, have such by means of cœcal prolongations from the air-bladder, and not by a chain of auditory ossicles, which appear to be absent in marine fishes. This leads one to inquire whether there are any fresh-water fishes that have this connection, as observed in sea forms. The perch has no auditory ossicles, and I should think its origin may be given as marine; and the same conclusion may be come to of the trout and anadromous salmon.

In short, the air-bladder in fishes is the homologue of the lungs of the superior vertebrate forms; in some of the higher sub-classes it serves as a lung, depurating the blood; but in the majority of true or teleostean fishes it is employed for one or both of the following purposes: as a float, enabling its possessor, by compressing or dilating it, to sink or rise to any desired level in the water; or, secondly, that it assists hearing by communicating with the internal ear: that in those forms in which it has an auditory function, we perceive two very distinct modifications, for among marine Physoclisti a prolongation of the air-bladder passes forwards to the interior of the skull, while in fresh-water Physostomi, although a similar connection exists, it is by means of a chain of auditory ossicles; while in such fishes as live the life of ground-feeders a still further change may take place, in the air-bladder itself being more or less completely surrounded by osseous walls, formed by the growth of the parapophyses of some of the anterior vertebræ.

RESPIRATION.

Respiration in fishes, excluding the amphibious forms, is fundamentally the same as in the higher vertebrates, the blood being decarbonized at the gills, where any circulating carbon unites with the oxygen of the atmospheric air (which is nominally contained in the water), and is thus excreted as carbonic acid gas. Some fœtal sharks and rays have deciduous gills,* which are only present in the embryo (plate clxv).

The first circumstance which attracts attention is that generally the wider the gill-openings the sooner the fish expires after removal from its native element as observed in the mackerel or herring. On the other hand, those with narrow gill-openings frequently live some time after their removal from the water as in the common eel. For as the delicate fringes of the gills become dry they adhere one to another, thus mechanically preventing them from acting, and consequently the blood cannot be decarbonized. Irrespective, however, of the foregoing cause a larger amount of oxygen is necessary for respiration in some fishes (as herrings) in comparison with their size than in others as the common carp, which has a much lower vitality. Suffocation may also be produced, due to the gills being choked with mud. Likewise consequent upon heat the air which should be in the water may become diminished or driven out, and when this occurs the fishes, to avoid suffocation, may be seen ascending to the surface to obtain that which they have not a sufficiency of lower down.

For the purpose of breathing a fish takes or gulphs in water by its mouth, which passes backwards to the gills, and is then discharged outwards by the gill-openings, which are of varying size, while as to numbers, there may be one on either side of or behind the head as generally seen in bony fishes, or a single opening below the throat as in the anguilliform *Symbranchus*, or several as in most of the Chondropterygii, and likewise in the Cyclostomata.

Among the bony fishes the gills supported by bony gill-arches are placed in a cavity behind and below the pharynx, while between these bony arches are clefts or slits permitting water to pass from the pharynx to the gills, subsequent to which it is discharged externally through the gill-openings. The branchial or gill-arches (see page xvi) are five in number, but are variously provided with gills on their outer surfaces, the majority having four complete gills, but occasionally the fourth has merely a single or uniserial gill, sometimes none at all. In our British frog-fish (vol. i,

* In young teleosteans, as the alevin stage of the trout, the gill-covers do not extend to over the gills, which are consequently bathed in the surrounding waters. Under certain conditions the pectoral fin assists in the breathing process (see page xi).

page 72) there are three gills, in the curious tropical *Malthe* belonging to the same family the Pediculati, two and a half, while the eel-like and amphibious Cuchia of Asia has merely one small gill belonging to the second branchial arch. The pharyngeal or inner side of these gill-arches may be simply covered with integument or possess projections of varying forms which have been designated gill-rakers, and whose numbers sometimes assist in ascertaining the distinction between two nearly allied species as in our two common shads (vol. ii, pp. 234, 236). These gill-rakers may be very fine, long, placed close together, and performing the function of a sieve by arresting the progress of anything but water from the pharynx to the gills. Or they may be placed somewhat wider asunder, be shorter in length, and then would be only efficacious in stopping large particles. In some forms they may be teeth-bearing tubercles, or simply rough. Irrespective of this sieve-like apparatus preventing foreign bodies passing from the pharynx through the clefts or slits existing between the branchial or gill-arches to the gills, their interbranchial slits may be decreased in size, or even obliterated; for in some forms, as in Cottus, no opening or slit is to be found behind the fourth branchial arch, and when this is the case merely a single or uniserial gill is present on it.

The gills or branchiæ of fishes may be destitute of support as among the Plagiostomata (vol. ii, page 287), or be supported by horny or cartilaginous processes placed along the outer convex edge of the branchial or gill-arches and fixed in the integment. Normally or in complete gills there are two rows of these rods, one along either edge, whereas in the uniserial or half-gills there only exists one row. Although all gills are essentially the same as to their formation, their appearance differs, thus among the Lophobranchiate forms (vol. ii, page 256) each gill expands towards its free extremity, whereas they generally become attenuated and compressed, while numerous varieties are observable.

The pseudobranchiæ, or false gills, which often exist, are situated more along the inner side of the gill-covers in teleosteans, or within the spiracles in Chondropterygians, or concealed under the integument so as to appear like a glandular body on the remains of an anterior gill which in the embryonic life of the fish performed respiratory functions, but which in the adult fish receives arterial blood.

Accessory respiratory organs exist in some fishes, especially tropical forms, as in the climbing perch among the Labyrinthici, the walking fishes among the Ophiocephalidæ, and the scorpion-fish *Saccobranchus* and the *Clarias* among siluroids or sheat-fishes. Joubert remarks that respiration may be carried on in *Callichthys* by air passing through the intestines; in *Doras*, *Erythrinus*, and *Sardis gigas*, the air-bladder performs this function.

TEMPERATURE OF FISHES.

The temperature of the blood of fishes is much the same as that of the fluid in which they reside, but in some forms wherein there is great muscular activity, as in the tunnies, the respiratory process is so energetic that it raises it to a much greater heat. Davy when making investigations upon the heat of a tunny fish, *Thynnus* (vol. i, page 100), observed that the temperature would appear to be about 12 deg. above the medium in which they swim, and at least 9 deg. above that of the surface of the water.

ORGANS OF CIRCULATION.

Fishes are provided with an arterial and venous circulation similar to what obtains in the higher classes of vertebrates, and possess one for general nutrition, one for respiration, and also a portal system. But of these only the respiratory circulation possesses any muscular contractile system at its commencement, while it corresponds to the right or venous side of the heart of birds and mammals. The heart, which is absent in the Amphioxus, in other fishes is small compared with the size of their bodies and lodged in a cardiac chamber or pericardiac cavity which is closed in osseous fishes, but communicates with the peritoneal cavity in the sturgeon and among the plagiostomes, while in the myxine this cavity is simply a continuation of the peritoneum. Although the heart is usually placed a short distance behind the lower jaw and between the branchial and abdominal cavities, variations in its position are found to exist. In the true Apodes it is placed far back and behind the scapular arch. It is mostly free in the cavity it occupies, but sometimes, as in the sturgeon or eel, it has ligamentous attachments to the walls of the pericardium. It consists of an *auricle* or atrium, having thin walls, and into which a large venous sinus empties itself, having brought the blood from the veins of the body: a thick walled and muscular *ventricle*, and an arterial bulb. The venous sinus is situated outside the pericardiac cavity in teleosteans, but within it in plagiostomes. The arterial bulb or enlargement at the base of the arterial system in teleosteans, termed the *bulbus arteriosus*, is a pear-shaped dilatation of the artery, elastic, but destitute of any contractility, while internally it may contain many trabeculæ and irregular pouches but no valves, but has at its base one, two, or three valves, or even four in the sunfish. Among the Chondropterygii this swelling differs in size, while internally its valvular system has been found useful in classification. Externally this bulb is but little developed among the Chimeras, is mostly conical among the sturgeons and

plagiostomes and a continuation of the ventricle having striated muscular fibres, internally it possesses no valves at its base, but is lined by several rows, while it regularly contracts, alternating with the contractions of the ventricle. Internally it is provided with transverse rows of longitudinally shaped valves, varying in number with the forms to which they pertain: among the Chondropterygii it has been termed *conus arteriosus* to distinguish it from what is seen in teleosteans and cyclostomes. From the arterial bulb, or rather a continuation of it, is the branchial artery, which sends off branches from either side to the gills, where the blood having been purified, is returned to the dorsal vessel or aorta which distributes it throughout the body. It will be unnecessary in this place to remark any further on the arterial, venous, or lymphatic systems in fishes.

If we except the aberrant form of Amphioxus, all fishes possess blood corpuscles, varying considerably in size, being largest in the lepidosiren, of rather less size in the plagiostomes, while among the bony fishes those of the Salmonidæ appear to be of the greatest diameter, but are inferior in size to those of the Chondropterygians. It contains red and colourless globules, the former being as a rule elliptical, but are round in lampreys; circular globules are not unfrequently perceptible in the blood of fishes.

TEETH.

The teeth of fishes are more generally concerned in capturing than in masticating their prey, and are varied in their form, sometimes differing with the age or sex of the individual, and found in various situations inside the mouth and contiguous parts, thereby furnishing an important aid in classification, assisted likewise by their external characters. Some forms are destitute of teeth, or possess them solely in the pharyngeal bones, but from the lips to all the bones entering more or less into the composition of the buccal cavity, there is a tendency of the mucous membrane in almost any of these parts to develop teeth, especially among teleosteans. This is also seen in some plagiostomes. Among osseous fishes teeth are most commonly observed springing from or more or less attached to bone. Teeth as a rule are simple, and may be isolated one from another, as in the porbeagle shark (plate clvi), or they may be compound and form a large plate with pavement-like subdivisions, as seen in Myliobatis (plate clxxvi). Among teleosteans they may appear as a bony continuation of the jaws, as in Tetrodons (vol. ii, plate cxlvii). In some, as carps, teeth are absent from the jaws, or they may be isolated, as in the anterior portion of the jaws in the wolf-fish (plate lviii), or in a single row, as in the blennies, a double row, as in the holibut (plate xciv), a treble row,

as in some of the Pagelli, in many rows, as in the eel (plate cxlii), or be deciduous with age, as in the body of the vomer among the Salmonidæ. Some teeth have broad and rounded molariform crowns, as in Pagrus (plate xi), or they may be laterally compressed, as in blennies, or of a lancet-shaped form, as in Trichiurus; while their cutting edge may have one, two, or three cusps, and be smooth or serrated. In some fish the teeth are like bristles or setiform; or arranged so close together as to appear like pile upon velvet or villiform; or mixed with rather larger ones, cardiform; recurved, barbed at their extremities; canine like; or compressed and cutting; of equal or unequal sizes; and more than one form may be present in a single fish. Some species have the teeth resting on a sort of basal joint or a hinge, which enables them on pressure being made to be reclined towards the inside of the mouth, but reverting to their original direction upon the pressure being removed. The principle is not identical in all these hinged teeth, thus in the angler (plate xxix) and the hake (plate lxxxv) elasticity is present solely in the substances constituting the hinge; whereas in the pike (plate cxxvi) this is not the case, but the bundles of fibres proceeding from the interior of the dentine cap are elastic (C. Tomes). Fishes' teeth are constantly shed and generally as constantly renewed by a second appearing from beneath or else to one side. This renewal of teeth is well seen in the shark, wherein a row from behind constantly fills up the one which is in use.

The composition of the teeth shows many variations, but principally consists of vaso dentine, which may be said to be dentinal tissue, into which vascular medullary canals are prolonged, sometimes externally covered by dentine which is not vascular.

THE INTESTINAL TRACT.

The commencement of the intestinal canal or the mouth is the common receptacle of water passing to the gills for respiration, and of food transmitted to the stomach for nutrition, while, as might be anticipated, its capacity is large and variously formed. But it is not my purpose to enter at present on the several purposes for which the mouth is employed, or the means by which these are effected, except to remark on the absence of the salivary glands, which in some forms seem to be represented by mucous follicles that open into the mouth below the side of the tongue, much saliva doubtless being unnecessary, owing to the moist condition of their food. Also that among the carp-like fish the palate is very sensitive, exceedingly vascular, while from numerous small pores mucus of a solvent character exudes, apparently to assist the digestion of food which the pharyngeal teeth masticate. The gastric portion consists of an œsophagus and a stomach,

between which a cardiac constriction is not so frequently observable as a change in the structure of the lining mucous membrane. In some forms there hardly exists any definite line of demarcation between the lower end of the stomach and the commencement of the small intestines, but in many a constriction occurs in this situation, termed the pylorus, although it must be observed that the orifices at the ends of the stomach are usually more or less approximated, in order that the food may be retained as in a cœcum. Occasionally the stomach occurs not in the direct course of, but to one side as it were, of the intestinal canal. A second constriction, marked internally by a more or less well-defined internal valve, shows where the small intestines terminate and the large ones begin.

Generally among teleosteans the various portions of the intestinal tract are sufficiently distinct to be distinguished simply by an external inspection: sometimes the differences between each part are so slight that the situation where the ducts enter give the best clue to the various parts.

If the intestinal canal is slit up and its inner surface examined, the commencement of the stomach is generally observed to be defined by increased vascularity and a more delicate lining membrane than that existing in the œsophagus. Its upper or cardiac orifice is usually larger than its lower or pyloric one, while the form of the entire organ is subject to considerable modification, being usually found in one of the two following divisions: the *siphonal*, which somewhat resembles a bent tube, as seen in the lumpsucker, flounder, salmon, carp, sturgeon, and most of the plagiostomes; and the *cœcal*, in which it ends in a blind sac, and the pyloric portion is continued from its right side, as observed in the perch, gurnard, weevers, John Dory, whiting, &c. An intermediate or transitional form sometimes exists, as in the sea scorpion or the turbot, irrespective of which certain deviations occur which it is not my purpose to enlarge upon. The Indian *Sciæna*, erroneously termed "whiting" (*Johnius*), has the pyloric portion of its stomach muscular, but this augmented thickness of the muscular coats may be best perceived in the mullets (*Mugil*), in which the cardiac portion is continued downwards into a blind sac, while the pyloric portion is thickened like the gizzard of a bird, appearing as a rounded or conical projection externally, and which when cut into is found to consist of thick muscular walls, the small cavity remaining internally being lined with a thick and horny epithelium. This gizzard-like stomach is evidently employed for grinding up hard food, and it is curious to observe how, when some fresh-water forms select hard substances for their diet, the coats of their stomachs may likewise become thickened. Thus in the gillaroo trout we find the ascending or pyloric portion of the stomach thickened. In the cyclostomes and leptocardii the intestinal tract is straight, but in the lampreys longitudinal folds are present in the œsophagus, and a single one along the intestinal tube.

Through the pyloric orifice, partially digested food reaches the commencement of the small intestines, and as a rule we observe that the distance from the pylorus to the vent is shorter in fishes than in most of the higher vertebrata. But of course the length of the intestinal tract differs in various classes, while its lining membrane is by no means of the same description in all. In the salmon or herring we find the length of the intestines shorter than that of the body, but in the former the intestinal lining membrane is raised into transverse folds, thus increasing the extent of their secreting and absorbing surface, which is also further augmented by the secretions of numerous cœcal appendages. In the herring, again, the cœcal appendages are numerous. In other forms we find the intestines themselves convoluted, thus increasing their length, and this is well seen among the carps. In the shad Cuvier observed that valvulæ conniventes existed in the intestines, while in the salmon the folds of the internal lining of the intestines increase in size, decrease in number, and become less oblique as they approach the rectum, or the commencement of the large intestine is marked by a large circular valve, which is succeeded by several others which are completely or incompletely transverse. This large intestine may be straight, as seen in the sturgeon or chimæra, &c., where the transverse folds may become continuous, and there is formed an uninterrupted spiral valve, also present in the sharks, the rays, and their allies, but which may be modified into transverse coils.

It is thus that in fishes economy of space is effected by an increase of the secreting and absorbing surface of the vasculo-mucous membrane lining the intestinal tract, whether such be merely raised into puckers, or these puckers be continued into transverse folds, or even forming a circular uninterrupted spiral valve or coil to the large intestine.

An examination into the cœcal appendages, also termed pyloric cœca, and pyloric appendages—what forms possess and what are deficient in them—under what circumstances they vary—and, lastly, what are their functions, show them to be questions respecting which much still remains to be ascertained. In different fishes they may be useful for different purposes—either as an absorbing or secreting surface, or both. Thus as observed by Krukenberg, in the perch they are lined by simply mucous glands, whereas in the herring they represent the pancreas, and contain a "tryptic" ferment. In some species these appendages are a modified pancreas, in addition to the very rudimentary form of this organ which has been detected as a minute glandular body, terminating in a duct, which opens by from one to three orifices into the intestines, close to the bile duct, but occasionally so closely attached to the latter as to be easily overlooked. The latter is seen both in fishes which possess pyloric appendages, as perch, cod, salmon, sturgeon; and in such as are deficient in them, as brama, gar-pike, and pike, while the sharks and rays are

furnished with a reddish-yellow and lobulated gland, which is more similar to what is perceived in the higher forms of vertebrate animals.

As to the common appearances of cœcal appendages,* if we commence our investigations among the osseous fishes, we see in some one or more small ducts, each ending externally in a blind extremity; these either surround the commencement of the intestine just beyond the pyloric or lower end of the stomach, or else spring from one of the sides of the first part of the small intestine, along which they may be continued for some little distance. We find in a single fish from one to upwards of a hundred of these cœcal appendages, each of which may open by a separate orifice into the intestinal canal, or two or more conjoining form a common duct, and thus diminish the number of openings, while in the bogue-fish (*Boops*), two cœcal appendages are seen at the termination of the intestinal tract. In the sword-fish (*Xiphias*), all the various appendages conjoin with the common tubes which empty their contents into the intestines. Passing from the osseous upwards to the cartilaginous or semi-cartilaginous fishes of the ganoid sub-class, we still find this gland present. Thus in the sturgeon (*Acipenser*), a mass of areolar tissue binds the various cœca together, forming it into a parenchymatous conglomerate gland.

The general appearance of the cœcal appendages consists of ducts of varying length and numbers, attached externally to the small intestines, into which they empty themselves. If these cœca are opened, they are mostly seen to possess a glandular lining membrane, where a glairy fluid is secreted, similar in appearance to the secretion from the internal surface of the intestinal canal. Chyme has likewise been said to have been found inside them. It seems probable that in the interior of these tubes a large amount of nutritive substances are present, for the tape-worms (*Bothriocephali*) so common in some fishes, as the salmon, are almost constantly found with their heads up these cœca, and from which they must obtain their subsistence. For it is reasonable to suppose that in choosing this locality they have been influenced by one of the following considerations:—Absence from the main intestinal tract, which is constantly being employed in conveying nutriment and excreta; or else in selecting some situation where the nutriment is more abundant.

If we take a general survey of these two classes, we observe that cœcal appendages are far more common among marine than fresh-water fishes;

* It may be as well before proceeding further to explain my plan for examining these appendages, for I employ, as a rule, one of the following processes. The easiest mode is to tie the œsophagus and inflate the intestines, appendages, and stomach by means of a blowpipe, tube, or quill, from an opening made in the intestines, or to tie the intestines and inflate from the œsophagus, while the use of a solution of chromic acid hardens the preparation. Should the fish not be sufficiently fresh for this purpose, it must be examined under water, when occasionally it can be injected with spirit.

also that in the highly-organized sharks and rays, instead of these appendages we find a spiral valve existing in the intestines, as already described.

URINARY ORGANS.

The urinary organs are composed of the kidneys as a secreting or excreting apparatus, the ureters, the bladder, and the urethra, the two last being absent in some fishes. The kidneys, according to Vogt and some others, appear to be composed of the Wolfian bodies, structures persistent among fishes, but which are not permanent among other vertebrate animals, whereas other authors deny this. Whatever they may be considered, still two kidneys, generally well-developed, are always present among fishes, except, perhaps, in the amphioxus. These organs, as a rule, are distinctly separated anteriorly one from the other, but sometimes more or less united posteriorly: they are placed close to the vertebral column, but separated from the abdominal cavity and the intestines by the peritoneum. To this rule there are exceptions, as among teleosteans, which possess an air-bladder where it likewise is outside the peritoneum, and is often more or less adherent to the under surface of the kidneys.

The size as well as the form of the kidneys is subject to great variation: in some teleosteans they are compact and restricted to the forepart of the abdominal cavity, but in others they extend far forward to the base of the skull and posteriorly, as seen in the eel, &c., to between the muscles of the caudal region, while their surface may be smooth or lobulated. The ureters, which receive the urine from the urinary tubes, are generally two in number, rarely three, while as many as five from either kidney, each of which separately opens into the urinary bladder, have been found in sticklebacks. These ureters are usually placed along the inner edge of the kidneys, and may be continued to their outlet, or they may unite in an urinary bladder which opens behind the vent by a short urethra sometimes confluent with, sometimes distinct from (and is then behind) the genital opening, while occasionally it is situated on a papilla. Among the Plagiostomes the ureters are short, and each forms a dilatation which anastomosing with its fellow, ends in a single urethra, and having received the vasa deferentia in the male opens into the cloaca behind the end of the rectum. Variations in the positions of the various parts are seen among the Ganoids and Dipnoids. Among the Cyclostomes, as the lampreys, the kidneys are in the form of an elongated gland, with detached portions, the ureters coalescing prior to terminating in the urogenital papilla. In the hag a long duct extends through the abdominal cavity, sending off short transverse branches, each of which ends in a blind sac, where a ganglion that secretes the urine is

placed. In the amphioxus the isolated bodies which are seen near the abdominal pore have been considered as the kidneys.

LARGE ABDOMINAL GLANDS.

The *liver* generally occupies a large portion of the abdominal cavity, being separated from the cardiac chamber by a species of membranous diaphragm. It is most developed among the plagiostomes, and as a rule contains a large amount of oil. Its form is subject to considerable variation, but it is generally lobulated, the most simple being found in the amphioxus as a diverticulum from the stomachic dilatation of the intestinal tract. As a rule a gall-bladder exists, and although it is generally seen at its lower surface, it may be lodged inside the liver near its centre, attached to the right lobe, or even be distinct from this organ, being merely connected to it by the cystic duct. Bile is removed from the liver by one or more ducts, which converge into and join the cystic duct, thus forming the ductus choledochus or common duct of the liver and gall-bladder, which empties itself into the intestinal canal, posterior to the pyloric end of the stomach, while in the plagiostomes it opens in the duodenum.

A *pancreas*, as already observed, is found in many teleosteans, in the sturgeon, and among the plagiostomes.

The *spleen* among fishes is found, except in the amphioxus, as a dull reddish body of a rounded form, usually placed near the stomach or commencement of the intestines. It is subject to considerable modifications.

BREEDING.

Fishes are diœcious, and although hermaphrodites have been observed in a few teleostean forms,* the sexes are as a rule normally present in different individuals. Some are monogamous, as the snake-headed and tropical *Ophiocephalus*, perhaps also our common pike, and many others. The majority, however, are polygamous, or perhaps mixogamous, in which latter the males and females congregate for breeding purposes, those of the former sex being in excess, and several attending on one female, or even changing about to another.

Among most of the cartilaginous fishes, *Chondropterygii*, of the order Elasmobranchs, as sharks, rays, and skates, a congress takes place between the two sexes, the arrangement of the sexual organs being somewhat similar to what obtains among the higher vertebrates. The male organs are mostly

* Hermaphrodites have been recorded among the following British fishes:—*Perca fluviatilis, Serranus cabrilla, Scomber scomber, Labrus mixtus, Solea vulgaris, Gadus morhua, G. merlangus, Lota vulgaris, Esox lucius, Cyprinus carpio, Clupea harengus, Acipenser sturio.*

compact, of a circumscribed form, and placed far forwards in the abdominal cavity. The vasa deferentia communicate with the ureters and terminate upon a cloacal generative organ, external to which on either side, and mostly attached to the anal fins, are the claspers. The female organs are (as in the male) situated far forwards, and remarkable by the modification of the two oviducts, which are not merely distinct from one another, but also from the ureters, which latter terminate upon a prominent urethral clitoris between the outlet of the oviducts. The ova are few, and the ovaries are comparatively smaller than in osseous fishes. Different parts of the oviduct may be functionally modified, being divided by a circular valve, which separates the upper or narrow portion where the gland is placed which secretes the egg purse, while the lower or uterine part is where the embryos are formed in the viviparous species. The ova are fertilized while still contained within the oviduct, where the ova are delayed, and the young may be either occluded in horny cases or even produced alive. Among cartilaginous fishes of the ganoid order oviducts are present with small ova.

During the breeding season certain additional developments may occur in some teleostean or bony forms: glands, as in some carps, may appear on the heads of fishes of either sex, while among the Salmonidæ a knob shows itself in the male sex on the extremity of the lower jaw in the salmon and some trout. Likewise in a carp, *Rhodeus amarus*, found on the continent of Europe, a long oviferous tube appears during the nuptial season, but as in the case of the knob on the jaw of the salmon is subsequently absorbed, while as a rule the female fish is larger than the male.

Considerable differences in the form of the male generative organs are observable among the bony fishes, but at the breeding season, all that are not sterile have a great augmentation in size. This organ, when arrived at seasonable maturity, is commonly known as the "soft roe" or "milt." It is not necessary for fishes to have attained adult size in order to be capable of the reproductive process or the milt to be fully developed, as this may be seen in the par or young of the salmon. Without detailing the different forms in which these organs exist, it will suffice to remark that when vasa deferentia are absent in the males, oviducts are similarly wanting in the females, the parallelism between these organs in the two sexes being, as a rule, very close. When the testis is single so is the ovary. But in some cases, as in the *Salmonidæ*, although vasa deferentia are present in the male there are no ducts in the female. In most osseous fishes the ovaries form two elongated sacs, closed anteriorly, but posteriorly continued into a short and wide oviduct, which terminates behind the vent and mostly before the urethra. The inside of these sacs is more or less lined with the stroma, or a peculiar tissue within which the ova are developed. In those forms in which the ova are hatched before extrusion,

the stroma does not extend to the hind portion of these sacs, for this locality serves as a sort of uterus, and is furnished with a large albuminous secretion, while internal incubation is going on. The products of the reproductive organs may be set free in the peritoneal cavity, finding their exit at the abdominal pore or pores: or these products may be taken up by the open mouths of the fallopian tubes, or distinct tubes conduct them all the way to their outlet.

The various modifications of the generative organs in true fishes are a simple testis or ovary, but no excretory duct; a partial oviduct united to the ureter, but not continuous with the ovary; or a testis having a long and complex duct distinct from the ureter. Among teleostean fishes breeding occurs in one of the following ways:—1. The eggs are hatched within the female organs, as seen in the oviparous blenny, *Zoarces viviparus* (vol. i, p. 211). 2. As in the majority of these fishes, the eggs having been excluded, are subsequently fertilized by the male, the milt or spermatozoa of the latter being brought into contact in the water with the ova or eggs of the female, when this microscopic body (the spermatozoon) obtains access by a minute orifice, termed the micropyle, into the interior of the ovum. In short, during the breeding of osseous fishes the generative organs perform the following functions:—"Semination," "ovulation," "fecundation," and "exclusion," to which in some forms is added that of "fœtation."

Simple as this process would seem to be, there are many interesting questions about it which are still unsolved and require attention. If all fishes' eggs were of one size, the micropyle and spermatozoids identical in all forms, the specific gravity of all ova without variation, and all kinds of fish propagated their species at the same period and took the same time in the incubating process, we should soon arrive at a state of inextricable confusion. There might be hybrids between salmon and minnows, perches and bullheads, sticklebacks and carps: and were these hybrids to prove fertile, in a comparatively very short space of time all land-marks would be obliterated; families, genera, and species would be things of the past. And if this did occur, the result could be readily foretold; now small forms obtain sustenance in little as well as in large pieces of water; but were these small forms to merge into the larger, our brooks, our lesser streams and ponds would no longer be stocked with fish; for the size of the stream and the amount of the food would be insufficient to maintain them in health, even were it sufficient to sustain life. And could we hope for a hardy race from young raised under such conditions? Or even were our fishes entirely restricted to our larger rivers, what would occur? Predaceous forms of destroyers, perhaps man himself, would soon diminish, and possibly annihilate them. Irrespective of which, deterioration in the size of parent fish may be equivalent to diminution in the size of the offspring, such being

one of Nature's methods of preventing the extermination of the race. For decreasing their size will cause them to be less sought after, and it will only be when the larger fish are left for breeders that larger offspring result. In short, when man or other causes afford to fish sufficient protection, then Nature assists in improving the race; when man or other destructive factors greedily kill all they can, then the breed dwarfs, and so possibly prevents its extermination.

To which ever division fish belong, they are generally perceived at the commencement of their breeding season migrating to localities most suitable for the reception of their eggs and the bringing forth of their young. The majority of marine forms seek banks, or are found nearer in shore or in shallower waters than such as they inhabit at other times. This arrival of gregarious kinds of mature fish occurs when they are ready for breeding, while their eggs are deposited prior to their leaving, so whether they come to perpetuate their race or seek food for preventing death in each individual of the species, it eventuates that at these periods breeding usually occurs, as may be observed in the herring or in the mackerel. Anadromous forms pass up rivers, sometimes for long distances, and then deposit their ova: among the most widely distributed of such is the shad, of which we possess two species in the British Isles, both found in the Severn, but up which they now rarely ascend in numbers to any considerable extent, due to weirs across the river, deficiency of water, or else its poisonous condition. The salmon similarly ascends from the sea to deposit its ova in rivers and streams, and this instinct of migration or necessity for exchanging its locality to a suitable breeding spot may be more or less observed among a large number of members of the family.

The season at which breeding occurs varies with the family of fish and the locality. This again is susceptible of further modification in accordance with the temperature and perhaps composition of the water, the amount of food procurable, and many other local circumstances. Likewise there is some condition in the fish itself respecting which we know but little, but which plays its part. It is easy to understand that during very cold winters breeding is usually late, which may be partly occasioned by the ova taking longer to hatch, as well as by the parent fish being later depositing its eggs. The period at which the *Salmonidæ* in these isles breed may be roughly estimated (unless under exceptional circumstances) at from the commencement of September until the middle of January or February. In 1866 some brook trout eggs were despatched from Hampshire and Buckinghamshire to Tasmania, and the first young reared in the Antipodes formed their redds in July, 1869, or during the coldest season of the year (see vol. ii, p. 60). But easy as this theory would be in order to explain the different months fishes select for breeding purposes, there exist many exceptions

which are still open to discussion. Some rivers are stated to have early and others late breeds of salmon.

The same thing occurs in marine fishes; thus there is not a month that herrings cannot be found breeding around the coasts of Great Britain and Ireland. In the United States the Fishery Department has ascertained that the codfish *Gadus morhua* breeds during nine months of the year, namely, from September until May.

Some fishes merely breed once a year, while others do so more frequently. During the breeding-season a few forms, as the salmon and the shad in our fresh waters, and the herrings of our seas, appear to decrease the amount of food they consume or even entirely cease feeding; this may be necessary in some gregarious marine forms for the following reason: Unless they congregate together at this period there would be great danger in the deposited ova not being fertilized by the milt, for we know that should such not take place in a short time in fresh water they do not become vivified. Should, therefore, fish in this c ndition have to be roving about in search of food there would be the possibility that large quantities of eggs would be spoiled, while the forms which produce the greatest number of ova are often those which live in large communities.

Whether breeding occasions any deleterious effects upon fish is capable of more than one answer. Fresh-water forms that produce a moderate number of eggs, or do so gradually, or at more than one period in the year, do not appear to be so much affected as those which deposit large numbers of ova, and complete this process in a short space. As a rule, the result of breeding is that the parent fish goes out of condition, and continues so for a longer or shorter period of time. Herrings, as soon as they are "spent," fall off in condition; the salmon kelt becomes absolutely unwholesome, or else so lean and flabby as to be unsuitable for the table.

Fishes' eggs are of various sizes, and this size is not in relationship to the magnitude of the species — thus a codfish has much smaller eggs than a trout, and a common carp than a char. While some forms deposit their ova in the sea, others do so in fresh-water, which may be stagnant, semi-stagnant, or running. Some eggs are so light that under certain conditions they may float, as of the cod in the sea, while those of the white-fish *Coregonus* are semi-buoyant, and those of the herring sink; those of the gar-fish and its allies are attached by filaments or tendrils to foreign substances, while others are likewise adherent, due to a secreted mucus, as in the lump sucker (*Liparis*), which deposits its ova on the inside of the valves of dead shells, as a butterfly does on a leaf; while the fresh-water bitterling, *Rhodeus amarus*, of Continental Europe is furnished during the breeding season with a long oviferous tube enabling it to insert its eggs within the valves of the fresh-water mussel.

Among the curious pipe-fishes the eggs are transferred from the female to the male, and in most of the species the duty of hatching them devolves on the latter sex, for which purpose they are deposited up to the period of the evolution of the young in ovigerous sacs variously placed (vol. ii, page 256). In the horse-fishes (*Hippocampus*) in pouches under the tail; in our ocean pipe-fishes (*Nerophis*) in rows along the breast and belly. Whether this phenomenon of carrying about the eggs is to protect them from danger or in order to change the water in which they are kept may be questionable, but as these fishes have several times been hatched in aquaria, it would seem to be for the purpose of protection against foes. Similarly we perceive siluroids, *Arünœ*, of the Eastern and other seas in which the males carry about the ova in their mouths, either continuously or temporarily, and the young may be observed emerging from the ovum while it is still in the maw of the male fish. Teleosteans, which have no oviduct, as the *Salmonidæ*, deposit their eggs detached one from the other; but such as possess oviducts often have them surrounded by a viscid secretion formed from the lining membrane of the oviduct and agglutinating them in lumps or cords.

The sticklebacks or pricklebacks of this country (vol. i, page 236), whether marine or fresh-water species, form a nest for the reception of their eggs, which has an entrance on one side and an exit on the other, so that either parent can readily pass through. When the eggs have been safely deposited in the nest, and the necessary fertilization accomplished, the male takes charge, driving his help-mate off to a safe distance in order to prevent her making a meal of the ova. Mr. Warrington ascertained that in a few days in the fresh-water species the nest was more and more opened by the male, evidently owing to the necessity for oxygenation, and he hovered over it, causing a current of water to be propelled across its surface by fanning it with his fins, and after about ten days the nest was destroyed and minute fry appeared, over which the male kept guard. Some of our marine wrasses of the genus *Crenilabrus* have been observed to construct nests, in which occupation both sexes assist. The river bullhead, *Cottus gobio*, forms a hole in the gravel at the bottom of a stream, and here it keeps guard over its eggs as well as over the infant progeny. While in tropical countries there exist many forms of nest-constructing fishes, and the parents, more especially the male, protect the young until old enough to shift for themselves.

In investigating single families of fish, or genera, it is interesting to see how even closely related forms differ in the places where they deposit their ova, or the period when they breed. Among the herrings we find that the common herring is breeding in some one or other spot around our coast almost every month in the year; that it deposits from ten to thirty

thousand eggs, which are agglutinated together in a mass, and subsiding to the bottom, attach themselves to sea-weeds or other suitable substances; let this nidus for the eggs be trawled away or otherwise destroyed, and the herrings may permanently, or at least for an indefinite number of years, migrate to a more suitable spot. The sprat gives eggs of about 0·04 in. in diameter, and these likewise sink to the bottom, but not in a mass or covered with adhering substance, as in the herring. The shad of our waters has not yet had this question investigated; but in the United States the Fish Commission find that in the species which is most prized there, *Clupea sapidissima*, the eggs sink, but that they require to be kept in constant motion. Those eggs which normally float are more susceptible to atmospheric changes, and possibly this may occasion much loss. Thus in one genus are forms in which the eggs are agglutinated into a mass, sink, and become attached to suitable fixed objects: in another they simply sink: whereas in a third, although they sink, they require to be kept in constant motion.

If we take another family for investigation, as that of the salmon, trout, and their allies, we find interesting variations. The common smelt, *Osmerus eperlanus*, covers stones, planks, and suitable objects with its adherent ova, and which are placed near the level of high water. These eggs are furnished with fine filaments on their outer surface, which filaments expand at their distal extremities into the form of a sucker for attachment. The grayling deposits its ova about April or May, or even earlier, on the gravel at the bottom of a suitable stream; they are not placed in a nest and appear to be very delicate; their size is rather less than seen in the trout. But the salmon, trout, and char fan up the gravel, thus forming a trough wherein the ova are deposited, and subsequently the nest, redd or rid, is covered over with the gravel, and here the eggs are left to come to maturity. In all these forms the eggs are heavier than the water in which they are deposited, still they are treated either by being laid on the bed of the stream or below the gravel, but the fish culturist has ascertained that this placing them within a bed or nest is not essential to their hatching.

Before passing on from the eggs and how deposited, I must draw attention to a rather curious phenomenon, but too often seen, and which in its most fatal form is known as fish being egg-bound—dying, in fact, unable to void their ova, similarly to fowls unable to lay their eggs, or higher vertebrates which cannot bring forth their young. Some fish, as the herrings, which exude their ova in the open sea, can scarcely be subjected to any extraneous force in order to assist this process, but that such does take place in some fishes has been ascertained. The gold carp, *Carassius auratus*, is one of these forms, and the male (or rather relays of them) have

been observed in an aquarium to roll the gravid female like a cask along the bottom of the tank, and to continue this operation without relaxation for a day or two until the wearied female has extruded her ova. The female river lamprey is said to be assisted by the male twisting himself around her, and so expressing the ova and milt, the suctorial mouths of both parents being at this time attached to a stone or other suitable stationary object. While it does not appear unlikely that the female salmon or trout when forming the redd or nest by lateral strokes of the side and tail portion of the body is by such active exertion assisting in ridding herself of her eggs. It has been asserted that among these latter fish when the eggs are ripe there is no power to prevent their escape, but at Howietoun it is found that if the parents are placed in a wooden tank, having smooth sides and bottom, and through which a stream flows, ovulation may be deferred days, and even weeks.

The number of eggs deposited by teleostean fish is, as already remarked, exceedingly varied; thus, a perch of 1½ lb. contained 280,000 ova, one of 3 lb. 2 oz., 155,620; a ruff, of 4¾ oz., 205,000; an angler, of 1 lb. 13 oz., 1,427,344; a mackerel, 18 oz., 546,681; lump-sucker, 6½ lb. weight, 207,700, at 9 lb. 8 oz., 155,000; cod, at 11½ lb., 1,800,000, but upwards of 3,000,000 have been taken from one; haddock, 2¼ lb., 169,050, at 9 $\frac{9}{16}$ lb., 1,839,581; coal-fish, at 21 lb., 8,260,000; pollack, 12 lb., 4,200,000; hake, the roe of which weighed 15½ oz., 1,500,000; ling, 20 lb., 19,985,400, one of 100 lb., 160,000,000; burbolt, 128,000; halibut, 3,500,000; turbot, 5 lb. 9 oz., 14,311,200; plaice, 4 lb. 15 oz., 144,600; flounder, 24¼ oz., 1,357,400, at 6¾ oz., 351,026, at 3½ oz., 225,568, at 2¼ oz., 133,407; sole, 1 lb., 134,000; salmon, about 900 to every 1 lb. weight, but may exceed this, one of 20 lb. contained 27,850; trout, about 800 to every 1 lb. weight; charr, ½ lb., 1,230; pollan, 11¾ oz., 6,156; smelt, 2 oz., 28,278, and in a second the same size, 36,652; pike, 35 lb., 43,000, 32 lb., 595,200, 28 lb., 292,320, a second 700,000, 24 lb., 224,640; carp, at 9 lb., 600,000, 16½ lb., 2,059,750, 21½ lb., 1,310,750; barbel, 7,000 to 8,000 ova; roach, 28 oz., 480; tench, 4 lb., 297,000; bream, 130,000; white bream, 108,000; herring, 10,000 to 30,000; pilchard, 60,000; conger, 15¼ lb., 6,336,512; the small numbers of the cartilaginous fishes have been already referred to.

One reason adduced for sea fishes not requiring protection at any period of their lives is that they deposit so many eggs, and that these will suffice to meet all and every device man may employ to effect their capture. Here the zoologist may well inquire whether breeding in fishes differs from what obtains in the remainder of the animal kingdom, wherein the powers of increase have been apportioned to the needs of the individual, for where man has interfered, as in birds, ground game, seals, &c., protection has had to be afforded in order to prevent annihilation of the species. It would

seem that the various sizes, modes of deposit, and numbers of fish eggs, must be on some definite plan, not a chance medley, destitute of any order and deficient of any scheme. We observe, as in many other forms of life, that the more voracious class, as sharks and rays, have fewer young than the herring and the mackerel, that fish which give the most eggs take the least care of their offspring, and, until the contrary is proved, we are justified in assuming that where the most numerous eggs or young are produced by a species, there the greatest destruction occurs, and finally that fish have only sufficient ova for the purpose of compensating for normal loss.*

But even when fishes' eggs have been deposited in order that they should hatch it does not follow that it is only necessary to place them in a hatching box, and then turn salt-water over marine ones and fresh-water over those of our streams and lakes. The precautions to be taken by the fish culturist I do not propose alluding to here, but certain physical phenomena are very important.

Some fishes are *sterile* from various causes. Thus the common eel, a catadromous form, or one which breeds in the sea but passes its life in fresh-waters, is believed only to deposit ova once during its lifetime, and then either dies or returns to the rivers, and is sterile for the remainder of its life. It has been observed that among the *Salmonidæ* sterile forms are seen, but which are believed to be only temporarily so, as for one or two seasons.

Fish may also be sterile consequent on disease. Thus I have seen in a mackerel the oviduct occluded due to disease having set up inflammation, and occlusion of the outlet of the oviduct, and thus the preceding year's eggs have been retained and formed a large tumour.

Eggs themselves, of course, may fail in hatching, due to sterility or deficiency of fecundation, injurious surroundings, as by being carried by floods and currents into unsuitable places, or consequent upon the effects of disease, while shocks given to them during incubation produce monstrosities and if severe, death. While fishes' eggs are more or less circular or oval, and of varying colours, being pea-green in some sheat-fishes or siluroids, and among the *Salmonidæ* they may be coral-red, yellow, or pure white, the herrings usually have a slight pink tinge; those of the sprat are colourless.

I have already remarked that fishes' eggs before they are fertilized have a small orifice or micropyle into which the spermatazoon enters, but it is evident in sea fishes that if the egg floats at the surface and the milt is beneath, the chances of fertilization must be diminished, unless some means are taken to obviate this. Also that there must exist some mechanical reason why fish eggs float in some forms, and sink in others. Of course, the

* As a rule fish hatched from small ova are feebler than those from large ova, and Ryder remarks "some species leave the egg with the throat perforated and other forms do not." The shad cannot swallow at the time of hatching.

principal cause which makes eggs subside to the bottom is that their specific gravity is greater than that of the fluid in which they are floating, unless due to some mechanical arrangement (as the presence of filaments) they are attached to foreign substances, when they would sink or swim in accordance with the condition of the body to which they were attached, as the eggs of the marine gar (*Belone*); or a fish (as a perch) may have its ova in a band-like state, when it selects rushes, reeds, or grass growing in the water or a piece of wood or other hard substance, against which it (the female) presses itself until one end of the band has become attached, then swimming slowly away the eggs are voided. But sometimes eggs, as of the cod, float in normally saline water, and questions have arisen as to the position of the micropyle. Dr. Ransom in 1854 found that in the trout, salmon, and grayling it corresponded to the centre of the germinal pole. Here the formative yelk or germ collects, and having attached to it some oil drops, always floats uppermost. In the Spanish mackerel and some other American forms a single large oil sphere keeps them buoyant, situated at a point immediately opposite the germinal disk, which is constantly inverted or carried on the lower face of the vitellus, thus acting exactly the reverse to what is observed among the *Salmonidæ*. In the cod no oil drop exists, but the egg is so light that it behaves like the foregoing. It is seen in the cod fisheries that at the period of breeding the egg floats with the micropyle directed downwards, and as a consequence the milters are found to swim lower than the spawners, the milt must consequently ascend.

It will now be necessary to briefly observe upon the physical changes which fishes' eggs have to undergo prior to their being rendered in a suitable condition to continue the species. If we examine under the microscope the ova of an osseous fish, as a stickleback, as remarked upon by Dr. Ransom, we may perceive around the eggs before they are deposited and holding the mass together is a viscid layer or secretion from the oviduct of the female. This secretion will for some time resist the imbibition of water in the unimpregnated ova, so that they have been observed to remain flaccid at least two and a half hours after immersion. Subsequently it seems to set round the eggs, making them cohere firmly together. The egg itself may be said externally to have a double cortical layer, the two being divided by an interspace; the outer of these, which is rather thick, may be termed the yelk sac, and is in immediate contact with the second internal or vitelline membrane which surrounds the yelk ball within the yelk sac. The outer membrane of the egg is distinguished in one spot by a number of cup-shaped or mushroom-like processes, which cover about one-fourth of its surface and mark the germinal pole. In the centre of these small elevations is the micropyle, consisting of a funnel-shaped pit directed towards the centre of the egg, and continued inwards as a narrow tube with

the inner end opened. This outer covering of the egg is changed by the imbibition of water from an easily torn membrane into a firm elastic one. The yelk-ball, or that portion surrounded by the vitelline or inner membrane, contains those essential portions of the egg which are subsequently directly transformed into the germ, and into which the micropyle opens. Between the two layers is a space, small in the unimpregnated egg prior to the imbibition of water, but which becomes filled, forming what has been termed the breathing chamber, a space increased probably also in size by a contraction of the yelk. In the stickleback this absorption of water from the outside commences near the micropyle, and gradually extends throughout the chamber; but in most osseous fishes, Ransom observes, water enters freely through the yelk sac, and the breathing chamber may commence simultaneously at all parts of the surface. It is only during this period when absorption is going on that fertilization can take place, and the spermatozoon obtain access by the micropyle to the germinal spot. When the air-chamber has been filled with water the outer covering of the egg hardens and become elastic; it is no longer soft and adhesive, and it "frees" itself from what it is attached to.

In this place it is unnecessary to go further into the embryology of osseous fishes, neither will it be required to prove that the elements for respiration must be received through the outer coat from the surrounding water. Here, however, it becomes needful to point out that as oxygen has to be imbibed through the outer covering of the egg certain mechanical influences may be at work to prevent this absorption, and so to decrease or altogether cut off the necessary aëration. In some fishes the breathing chamber is very large, swelling the egg to as much as double its original size, and it is evident that were these eggs fixed close together prior to distension, one of two things must occur, either their due expansion would be checked by one pressing against another, or some must give way.

I have already mentioned the eggs of the common smelt which possess filaments that adhere to contiguous objects: if these filaments are torn off the egg dies. Should many be placed together prior to imbibition they give the appearance under the microscope after the air chamber has become filled that they are honeycombed, which is due to the number of facets the eggs show owing to pressure one against another. Irrespective of injury from pressure, it is obvious that due aëration of the yelk will be stopped, and as a result death will most probably ensue.

Fish ova, as of the *Salmonidæ* and of some other forms, have been transported long distances, as from Europe to the Australian Colonies, Canada, and the United States. The first experiment of employing ice for the purpose of conveying trout and salmon eggs through the tropics is recorded

in volume ii (page 77). Davy ascertained many years since that ova in moist air retain vitality several days, and they may safely be sent in damp moss. In 1880 Max von dem Borne experimented on whether salmon eggs which had been fertilized by the dry process (or such as had not been brought in contact with water) could be transmitted long distances without the addition of any fluid. This year 34,000 trout ova were despatched to New Zealand in a modified refrigerating chamber. Moistened air passing in a current through the chamber was kept down to a temperature never below 32 deg. or above 34 deg. fahr. The eggs were arranged in trays lightly covered with moss, and the dead ones were daily removed. Nearly the whole number reached their destination in perfect safety.

It has been suggested that such fish ova as are deposited at the bottom of ponds might be transported long distances with safety enclosed in mud, a subject worthy of trial, but great care would have to be exercised as to the character of the water in which the experiment is tried. Fish which deposit their ova on bushes are placed in boxes thus lined, but with movable sides, so that they with the bushes and adherent ova can be transported in carrying boxes to the desired localities.

The milt of fish has been successfully employed some time after being taken from the parent; thus Sir J. Gibson-Maitland on November 25, 1879, successfully fertilized some trout spawn with salmon milt obtained the night before and corked up in a bottle. Likewise, as was long since pointed out by Bloch, ova or milt may be used obtained from fish which have been some time dead. On November 29, 1883, 1000 eggs of the common brook trout were thus treated at Howietoun with the milt of a par which had not been dead many hours, but the result has been that there was insufficient vitality in the milt to fructify a single egg. It has been remarked at Howietoun that eggs from young mothers give a larger percentage of deaths than those of older fish, this it appears probable affects the fertilizing property of the milt.

The period which fish eggs take incubating is not only exceedingly varied among those of closely allied species, but it is likewise affected by many extraneous causes. Those of sea fishes, as a rule, would appear to hatch in a shorter period than those of fresh water ones. The eggs of the herring normally incubate in about three or four weeks, but the escape of the young can be considerably delayed by keeping the water very cold, while its saltness or the reverse exercises no appreciable difference. In the Baltic the German Fish Commissioners found that with the water at 53 degrees the eggs hatched in a week, whereas with the temperature of the water at 38 degrees they took six weeks. In the eggs of the cod fish the American Fish Commissioners observed that hatching took place between the thirteenth and fiftieth days, according to the temperature of the water, while

Sars in Norway found some to hatch on the eighteenth day. The eggs of the haddock in the United States required an average of nine days, and the shortest period observed was eight days, while those of the coal fish, *Gadus pollachius*, hatch in four or five days in water of moderate temperature.

But if we can find such a difference in the cod family as to the time required for incubation to be from four or five days to six weeks, still greater variations are perceptible among those of the salmon family. At Howietoun the eggs of the smelt, *Osmerus eperlanus*, kept in the trout hatching house, took about forty-two days, but on the water being a little warmer they came out by the thirty-fourth day. In the same establishment, with the water kept at about 44·1 degrees, the brook and other trout took from seventy-one to seventy-two days; the American char, *Salmo fontinalis*, seventy-three; and the salmon seventy-seven. But the foregoing are subject to wide variations of time (by decreasing the temperature of the water), as of the trout up to 114 days, and the hatching of the salmon has been delayed to the 145th day, or even more, and acting upon this knowledge the eggs of members of the *Salmonidæ* have been transmitted in safety to the Antipodes.

Here I would draw attention to the various attempts which have been made to prove that salmon can breed in salt water, a proposition advanced by some estuary and shore fishermen, apparently in order to show that there is no necessity to have any restrictive legislation on salmon fisheries, but that everyone should be permitted to fish as he pleases, while the fish ought to continue their species in the sea and their young to ascend rivers to be captured—a view long since shown to be entirely erroneous, and which is referred to in vol. ii (p. 63). In fact, with the exception of catadromus forms, as the eel, we do not possess any fresh-water fishes that breed in salt water.

At the Fisheries Exhibition of 1883, the Commissioner from Canada, Mr. Wilmot, informed us that salmon can be detained in salt water until ready to be stripped of their ova and milt, which can then be raised in fresh water. But several experiments have all ended in one result, the eggs having died in salt water, as have also all the young; consequently, if salmon from any cause are prevented ascending rivers, and have to drop their eggs in saline or brackish water, no young will be hatched, while eggs or young placed in brackish or salt water will die.

I remarked in 1882 that at Sir James Gibson-Maitland's fish-ponds at Howietoun, the Lochleven variety of trout produced eggs of different sizes in accordance with the parents' age. Thus fish hatched in 1876, or six-year-olds, gave ova, thirty-two of which filled the length of a glass grill, whereas those females which had been hatched in 1875, or seven-year-olds, furnished eggs twenty-seven or twenty-eight of which occupied the same space. Not only does this occur in the Lochleven variety, but also in the brook trout and the American char; and Dr. John Davy found among

those of our common char which he examined a variation in diameter from 0·16 to 0·20 of an inch. Even in the common stickleback Ransom has observed that all the eggs of the same batch have not exactly the same dimensions when ripe, and still less have those of different individual parents. A similar variation in the size of the eggs corresponding to that of the parent has likewise been noted from trout at Otago.

The same phenomenon has been observed in the United States, where the Fish Commissioner on the M'Cloud River in 1878 remarked that the parent salmon were unusually small, their average weight being under eight pounds. This small size was stated to be undoubtedly caused in whole or in part by the fishing at the cannaries of the Sacramento, where the 8 in. meshes of the innumerable drift nets stopped all the larger salmon, but let all the small ones through. The eggs when taken proved to be at least a third smaller than those of most previous years, and the average number of eggs to the fish was about 3,500, against 4,200 in the previous year. In this instance the smaller salmon produced the smaller eggs, but whether the decreased number was not due to the decreased size of the spawners is not evident. Livingston Stone adduces another instance, asserting that American trout or char living in spring water (which means deficient food) develop smaller eggs than such as reside in brooks. Or poverty in food has the same effect as younger and smaller fish in diminishing the size of ova. This of itself would lead one to suspect that small eggs which may be caused by deficient sustenance in the parent will not produce the largest fry. This difference in the size of fish eggs, which among *Salmonidæ* increase in bulk up to a certain age, must have very important bearings upon their artificial breeding. For the size of the micropyle must be in a certain ratio to the size of the eggs, consequently larger eggs of the same species will admit larger spermatozoa than smaller ones. It has been maintained by some fish culturists that very great difficulties, sometimes even amounting to impossibilities, occur in crossing trout with salmon, or rather fecundating the eggs of trout with the milt of the salmon. As this was not found difficult at Howietoun when the eggs were taken from fish that had been some years in the ponds, whose eggs were approaching in size those of the salmon, it appears to me that the difficulty is merely a mechanical one, due to the size of the micropyle.* This, I believe, is a complete solution of how to obtain crosses between the salmon and the trout.

This brings us to the consideration of whether larger eggs, the produce of older or better fed fishes, will eventuate in an augmented size of the offspring, irrespective of the question of changing the locality they inhabit, or increasing the space or amount of water they reside in. Two sets of

* Mr. Arthur tells us, that in 1880, one trout at Otago yielded about thirty eggs double the size of all the other ova she passed, and they hatched out just the same as the rest.

Lochleven trout were stripped on the same day in November, 1882, the parents of one being six-year-olds, and of the other seven-year-olds. The eggs were similarly treated, hatched in the same room during January and February, 1883, and turned into two ponds of similar size, each 100 feet long, and fed by the same stream. In the upper pond were the progeny of the six-year-old; in the lower, which received the stream after passing through the upper pond, those from the seven-year-old. On November 29, 1883, the fry in the upper appeared to average about 2½ in. in length, and in the lower about 3½ in., showing that the offspring from the older parents had developed the most satisfactory results. I selected three of the finest fish from each pond; those from the upper averaged a little over 3 in., while from the lower they were nearly 4 in., or at nine months of age those which were the progeny of seven-year-old parents were nearly a quarter longer than those which were descended from six-year-old parents. In March, 1884, I again visited these ponds, and found the foregoing results were being still continued. The ponds were subsequently cleaned out and restocked with young trout, the offspring of parents of the same age, and in August, 1884, there was no perceptible difference in the size of those in the two ponds. If the eggs of older fish (up to a certain age) give larger and quicker growing offspring than do those from younger ones, it shows us that fisheries in which only small parents are left as stock may not improbably suffer a deterioration in the race, and this, irrespective of food, may be one cause of how fisheries fall off.

Finally arises the consideration of what benefit to mankind in general are investigations into the breeding of fishes? Here I shall merely enter upon a few, some being now carried out successfully, some experimentally, and, lastly, some theoretically suggested. In a state of nature salmon and trout eggs are subject to destruction from many foes, and it has been computed that although each female is provided with many hundreds of ova, only about one in nineteen of such as are left in the natural redds ever hatches, and only four or five of these out of 30,000 eggs arrive at maturity and are fit for the table; whereas, taking Howietoun as an instance, it is found that from 90 to 95 per cent. hatch in a well-constructed fish cultural establishment, while the loss among the fry is inconsiderable. Irrespective of this the young can be turned into the rivers at times when they would be more able to shift for themselves than if they resided there from their earliest days. Without entering into the reasons, still it is patent to the most casual observer that the interests of the upper riparian proprietors of salmon rivers are not always in agreement with those of the estuaries and lower waters. The former consider the fish are reared in their territory, but that the produce is almost exclusively captured at or

near the mouths of the rivers. The lower proprietors in some places believing that the upper proprietors are helpless do not always listen to their complaints in an amicable manner, considering themselves masters of the situation. But as a knowledge of fish culture extends it will be found that, did they know it, exactly the reverse is the case. The upper proprietors might obtain such splendid breeds of trout for their rivers that they would not care to continue preserving the salmon. Or they might introduce a land-locked salmon, or one which does not descend to the sea but passes all its life in fresh water. Or hybrids between the salmon and trout might be sterile and not take on migratory propensities.

I have shown how by selection of parents larger and more rapidly growing trout can be raised, and these fish, provided they can obtain sufficient food, attain to a size now but seldom seen, but when observed being termed *Salmo ferox*. Thus eggs sent from small brook trout in Hampshire and Buckinghamshire to New Zealand have developed into 20 lb. and 30 lb. fish. But to obtain these fine breeds great care must be taken in keeping the parent fish in suitable ponds; if breeders of different years can intermix then the benefits of age may be lost. Thus it is the finest forms come from seven or eight year old parents, as has been ascertained at Howietoun, where the young the progeny of such are now being kept to be breeders in their turn, and it does not seem an unreasonable expectation to see in a few years such a semi-domesticated breed as these islands have never witnessed, and all this due to the enterprise of a single energetic individual.

Then there are the so-termed land-locked-salmon, which might prove invaluable to upper riparian proprietors, or those who possess large inland lakes, containing sufficient food for their sustenance, or where descent to the sea is rendered impossible from any cause. In Maine, in the United States, there is found a variety of the salmon which has taken on a lake-life and is said never descends to the sea; many of the eggs were sent over last year to this country, and the young reared from them were exhibited in the Fisheries Exhibition. The Canadian Commissioner observed that in some of the rivers of the Dominion of Canada the same variety obtains. From Lake Wenern, in Sweden, a few of these land-locked forms were received at the Fisheries Exhibition, some of which weighed as much as 15 lb.

It has been asserted that no salmon in our country has ever developed ova without first descending to the sea. Here, again, facts at Howietoun entirely disprove this assertion. Some young salmon were hatched in March, 1881, and in December, 1883, while still in the ponds some females were found with ova, and one on being removed in August, 1884, had numerous large eggs. These, being bred from, may form the nucleus, after one or two generations, of a land-locked race.

HYBRIDS.

It has been conclusively shown that hybrids are found both among marine and fresh-water fishes, whether raised artificially or existing in a wild condition, as might be anticipated when we remember that the milt of a male might readily in water attain a proximity to the egg of one of another species or genus. This has been more especially recorded among the carps (vol. ii, page 157, &c.) and the *Salmonidæ* (vol. ii, page 80, &c.) "In 1869," says Livingston Stone, "I crossed the yellow perch, *Perca flavescens*, with the glass-eyed pike, *Lucioperca*, both percoids, using perch eggs and perch-pike milt. The result was an embryo which continued to develop till the seventh day, when the development suddenly stopped entirely, although the embryo did not die. At this point it resembled the embryo of the same age of the yellow perch proper." Fraisse asserts that he has been able to effect by artificial fecundation a hybrid offspring between the trout and the burbolt. Leuchart remarks upon having reared hybrids between the female salmon and male trout, and from these he procured in due time milt and ova which were fertile. Other observers again have asserted that fertile hybrids are only of occasional occurrence, and that eggs produced from them may be incapable of fertilization. The hybrids between the salmon and trout instituted at Howietoun in 1879, have, so far as has been examined, given sterile offspring.

Some experiments were made by Sir James Gibson-Maitland, Bart., at his fish-hatching establishment at Howietoun. On December 24, 1881, 20,000 eggs of the Lochleven trout were fertilized by salmon milt and hatched on March 9, 1882. On March 13, 1884, there were 212 successfully transferred to Craigend. Among these were six above 10 in. in length, but some were as short as 2½ in., showing the great range of variation as to size which may be found in a single batch of young from the same parents and kept under exactly similar conditions of existence. One examined in August, 1884, was found to be a sterile female.

On November 29, 1883, 4,500 eggs of the Lochleven variety of trout (of the season of 1875) were milted from a par of the salmon raised at Howietoun, and the mortality among the eggs was 1 in 46. But although this was so, the curious fact remains that the milt of the par in this instance was insufficient to impregnate the trout eggs, so as to produce young in a strong and healthy condition, while weakly alevins either die or are next to useless for stocking purposes. Although some thousands of the young emerged from the eggs, all were at once seen to be suffering from what has been termed dropsy or blue swelling of the yelk sac, which proved fatal before long to the majority, only about 100 remaining in August.

On November 29, 1883, 3,695 eggs of the American char were milted from a par. The following is the monthly record of the number of dead eggs which were removed. In December 144, in January 1,527, and in February 401, or a total of 3,372 dead eggs. On March 12, 1884, 7 were alive, but in an unsatisfactory condition. The amount of fertilization received by American char eggs from young pars is evidently less than that afforded to ova of the Lochleven trout, the relationship being perhaps more distant between a char and a salmon than between a salmon and a trout.

On November 15, 1882, 2,000 ova from a Lochleven trout were milted from an American char (*Salmo fontinalis*), and on November 29, 1883, about 250 were living. On March 13, 1884, 211 were alive. When first hatched these hybrids were much malformed, monstrosities being numerous, while blindness in one or both eyes and bull-dog deformities of the snout were common. Some semi-albinos were nearly blind. In August, 1884, all were doing well, and a male having been examined was found to be full of milt.

This experiment was repeated on November 29, 1883, when 3,000 ova were taken from a Lochleven trout and milted from an American char. The deaths were in about the proportion of 1 in 17 eggs. The young were looking healthy in August, 1884.

On November 15, 1882, 8,000 ova of an American char were fertilized from a Lochleven trout, and on November 29, 1883, only 16 were alive, and on March 12, 1884, 8. Their state was unsatisfactory, the largest being a little over two inches in length. In this experiment when first hatched the young fry were greatly deformed; many had crooked spines, atrophy of the posterior portion of their bodies, with a general deficiency of fins, especially of the caudal. In August, 1884, the last 7 were doing well.

November 15, 1882, about 9,000 eggs of an American char were milted from a Scotch variety of char, and no monstrosities (as seen in the other two crosses) resulted, and 91 lively young fry were present at Howietoun on March 13, 1884, while in August, on one being examined, it was found to be a male nearly ready for breeding. On November 12, 1883, the experiment was repeated, and the eggs hatched on January 26, 1884. On March 13, 1884, there were at least 500 young alevins alive and doing well. On December 1, 1883, a third experiment was carried out. These hatched February 22, 1884, and upwards of 100 young were present on March 13, 1884.

Different species of *Salmonidæ* may be crossed, as the Lochleven trout and char, or various forms of char, and the young would seem to be fertile. If crosses between salmon and trout are sterile, and no longer migratory in their instincts, the question arises, will they be in season all the year round? Could the fish culturist raise a non-migratory sterile form, what an addition

it would be to the lake fisheries, also to the upper waters of our rivers, with, of course, the drawback that the numbers would have to be occasionally replenished.

INSTINCTS AND EMOTIONS.*

The instincts of brutes have received more attention from biologists than those of fishes. Some naturalists have asserted that the lives of the finny tribes are destitute of the joys and sorrows generally appertaining to vertebrate animals, attributing to them an almost vegetative existence. But fishermen are well aware that they are as eager to escape from danger or avoid capture as are the inhabitants of the earth or the frequenters of the air, which compels us to question whether their lives are as joyless as have been represented, if anger or affection are really unknown passions to them.

Fishes have certain means of demonstrating their emotions, as they are capable of erecting their dermal appendages, as scales or fin-rays, under the influence of anger or terror, similarly as feathers or hairs are erected in birds and mammals. But special expressions, as of joy, pain, astonishment, &c., we can hardly expect to find so well-marked in fishes as in some of the higher grades of animals, in which the play of the features often affords an insight into their internal emotions. Eyes without movable eyelids, cheeks encased with bony plates or covered with hard scales are scarcely suitable for smiling, while external ears are wanting. Still we perceive among fishes a distinct expression or change of colour, which is but slightly developed or even absent in many of the higher vertebrates. When one sickens its brilliant tints become less and less, or even entirely fade away, while the same result may follow being vanquished by a foe. But when in good health and residing in suitable localities, especially during the breeding season, their colours become vivid, and even a temporary accession of anger may cause a similar result.

When investigating, if fish are or are not destitute of affections, it is necessary to ascertain whether they show such to their companions or to human beings, irrespective of what they may exhibit to their partners or their offspring.. Mr. Arderon found that on separating two ruffs, *Acerina cernua*, the one he kept pined away, declining food until its companion was restored, when both became contented (vol. i, p. 12), and the same observer gave an account (Phil. Trans. Royal Society, 1727) of how he tamed a dace, *Leuciscus vulgaris*, which would lie close to the glass watching its master. Marital affection I have alluded to when referring to the breeding of fishes (page lxi).

* See "Instincts and Emotions in Fish," by F. Day, *Linn. Soc. Journal*, xv, p. 31.

Manifestations of anger have been well described in the accounts we possess of the Fighting Fishes of Siam. After remarking on the cock-fights of that country, Sir J. Browning adds that there is a little bellicose fish which attacks its fellows with great ferocity, bristling its fins, and exhibiting the most intense excitement. One of these, seeing its reflection in a glass, will violently advance head foremost against the shadow. Dr. Cantor observed that when this fish, *Macropodus pugnax*, is in a quiescent state, with its fins at rest—the dull colours present nothing remarkable. But should two be brought within sight of each other, the little creatures become suddenly excited, the raised fins and the whole body shine with metallic colours of dazzling beauty, while the projecting gill-membranes, waving like a black frill round the throat, add something grotesque to the general appearance. In this state it makes repeated darts at its antagonist, but both when taken out of each others' sight instantly become quiet. Even the little sticklebacks, *Gasterosteus aculeatus*, of our own fresh waters show great combative propensities (vol. i, p. 241), and after a fight between two examples a strange alteration takes place almost immediately in the defeated party; his gallant bearing forsakes him, his gay colours fade away, he becomes again speckled and ugly, and hides his disgrace among his peaceable companions, who occupy together that part of the tub which their tyrants have not taken possession of. He is, moreover, for some time the constant object of his conqueror's persecution. Here we perceive how the disgrace of defeat affects the spirit of the vanquished, which, reacting on his health, causes his brilliant hues to fade away. The victor, on the other hand, exulting in his victory, becomes more resplendent; he does not forget his triumph, and considers it no disgrace to occasionally it lord over his fallen foe.

Everyone who possesses an aquarium is aware how spiny-rayed fishes on being angry or frightened at once elevate their fins. The globe-fish, *Tetrodon* (vol. ii, page 271), are able to inflate their bodies when the spinate dermal scutes become erected; also the file-fish, *Balistes* (vol. ii, page 267), has been observed by Mr. Whitmee to swim rapidly past its antagonist and graze its side with its file-like lateral spines. In the Ohio a sheat fish or siluroid is found in which its first dorsal ray is strong and bony, and employed to kill others of a smaller size, for which purpose it swims beneath the fish it intends to attack, then suddenly rises and wounds it repeatedly in the belly. I have personally observed an Indian siluroid, *Macrones vittatus*, lying on the wet grass, which on being touched erected its dorsal and pectoral spines, and also emitted a sound resembling the buzzing of a bee, which was evidently a sign of anger or terror. Couch observed of our sticklebacks, *Gasterosteus*, that the bite of these little furies is so severe that he had frequently known it, when inflicted on the tail, to

produce mortification and death. These fish also use their lateral spines (ventral fins) with most fatal effect, and he had seen one during a battle absolutely rip his antagonist quite open, so that it sank to the bottom and died.

Certain fishes are endowed with specific modes of showing their being affected with anger or terror, although these same means may also be employed for the purpose of obtaining food; among these is the electric eel, *Gymnotus electricans*, of South America, which is furnished with electric organs of such power as to be capable of causing death even to large animals. Humbolt and others have recorded how the Indians, when they desire to capture this fish, drive horses and mules into waters which they inhabit, when, as soon as disturbed, these eels attack the intruders. They first glide under the horses' bellies and prostrate them by repeated electric shocks, which by degrees diminish in intensity, for long rest and nourishment are required to repair the galvanic force which they have expended. It has been held that the possession of this power affords them means of protection against alligators, while it is certainly employed against other fish which it requires as food, but its onslaught on intruding horses may be due to anger or terror. Even in British seas we find the torpedo, or cramp ray (vol. ii, page 330) endowed with this electric power. The electric shock which it occasions is thus described by Kempfer. In some cases the nerves are so affected that the person struck imagines all the bones of his body, and particularly those of the limb that received the blow, are driven out of joint. This is accompanied with a universal tremor, a sickness at the stomach, a general convulsion, and a total suspension of the mind. Quick-swimming fish have been found inside these torpedoes, and would appear to have been captured by means of electric shocks. Whether we are to consider the attacks made by sword-fishes, *Xiphiidæ* (see vol. i, page 143), upon passing vessels are due to anger at being disturbed, or under the impression that they are attacking their enemies, the whales, is questionable; but it is a well-ascertained fact that the planks of numerous ships, especially in the Indian seas, have been pierced by the strong rostral apparatus with which these fishes are provided either for offence or defence.

Fear is frequently observable. Thus some small forms were kept in an aquarium along with an *Antennarius*, and were evidently in great dread of their carnivorous neighbour, whom they continually tormented. But when attacking it they always took care to strike at its posterior part, although this was protected by a sort of coral. Many forms when hooked or netted will empty their stomachs, either through fear or else to facilitate their escape, by lightening their load. Along the sides of the pools and some of the rivers of India, gulls and terns may occasionally be seen congregating and

beating the water with their wings, so as to scare the fish, when they fall an easy prey. Sars has observed how pollack succeed in alarming a school of sand-eels, *Ammodytes* (vol. i, p. 329), and driving them towards the surface, when they become a prey to gulls from above and these fish from below. Similarly, porpoises have been observed to swim round masses of gregarious fishes, and when they were alarmed, feasting on them with impunity: the gar-fish, *Belone*, of the British seas (vol. ii, p. 146) may then be observed to mount to the surface and crowd on each other as they press forward. When still more closely pursued, they spring out of the water to the height of several feet, leaping over one another in singular confusion, and again sink beneath. The flying fish, *Exocœtus*, similarly springs out of the water to escape its rapacious pursuers (vol. ii, p. 155.) Members of the herring family, *Clupeidæ*, would seem to be those in which more predacious forms appear to induce terror. Thus the gar-pike, in the eastern seas, may frequently be seen pursuing anchovies along the surface of the water. Every angler is aware of the natural timidity of fishes, and keepers know how easily poachers are able to deter salmon from ascending fish-passes.

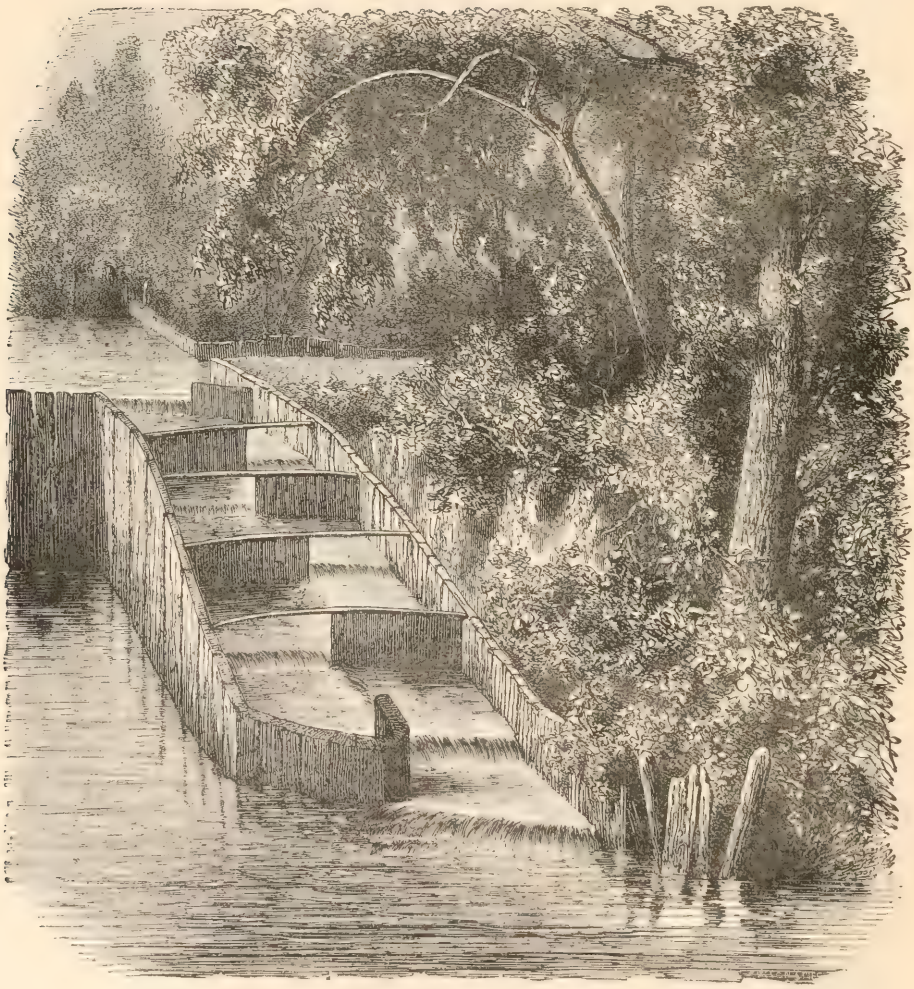
During the nuptial season, teleostean fishes (page lvii) have more resplendent tints than at any other period of the year, and this may be for the purpose of mutual attraction, as seen in the salmon, stickleback, &c. While in the United States a male of the John Darters, *Etheostoma blennoides*, kept in an aquarium, underwent, almost in an instant, an entire change of pattern in the colours on its body, upon the introduction of a female fish of the same species. Even after two weeks the novelty had not worn off, though its body-colours varied much from hour to hour, but had not reverted to its original dress.

Inherited instinct is a subject in fishes worth attention. Due to it the young of many sorts return from the sea to the localities where they were originally reared, and in their turn produce offspring inheriting the same tendency. Similarly, we may perceive inherited fear; a young fish just hatched will hide itself from the gaze of other animals.

Some fishes have the curious instinct of obtaining assistance from other forms in their search after food or their migrations from place to place; this latter being done in order to profit by the greater powers of locomotion in their host, from whose body, however, they draw no sustenance, but are commensals, merely partaking of such food as comes within their reach. Among these latter we have the sucking-fish, *Echeneis*, as an occasional wanderer to our shores (vol. i, p. 106). The *Fierasfer* (vol. i, p. 328), which is another rare visitant off our coast, is often known to seek its fortune inside the sea-cucumber or *Holothuria*, upon which it may be said to be a "free messmate." It works its way into its host tail foremost, while many of the young of our commoner forms seek refuge in *Medusæ*

and similar forms (vol. ii, pp. 281, 285, 297), phenomena very commonly observed in the Eastern seas.

Without entering more fully into details, it seems possible to claim for this class of animals the possession of attachments, whether as conjugal feelings, paternal or maternal affections, or even platonic friendships.



SALMON PASS.

CLASSIFICATION.

As to the system followed in this work I have simply accepted, so far as I possibly could, that employed in the British Museum Catalogue, as specimens are arranged in the National Collection in accordance with it. At the present time Ichthyologists may be considered as engaged in storing-up facts from which after a longer or shorter interval a general system will have to be evolved. Whether therefore one commences with the spiny-rayed teleostean perches, or begins from the higher and more specialized groups of sharks and their allies, seems to be a matter of trivial importance.

The following is the classification adopted :—

Sub-class, I—TELEOSTEI
- Order 1. Acanthopterygii, vol. i, p. 1.
- ,, 2. Anacanthini, i, p. 271.
- ,, 3. Physostomi, ii, p. 46.
- ,, 4. Lophobranchii, ii, p. 256.
- ,, 5. Plectognathi, ii, p. 267.

Sub-class, II—CHONDROPTERYGII
- Order 1. Ganoidei, ii, p. 278.
- ,, 2. Elasmobranchii, ii, p. 285.

Sub-class, III—CYCLOSTOMATA, ii, p. 355.

Sub-class, IV—LEPTOCARDII, ii, p. 366.

Although it is easy to refer to Families as groups of Genera and the latter as an assemblage of species, this merely brings us to the real question at issue, which is, *what is a species?* For determining this two lines of investigation may be followed : (1) the *morphological* or that which relates to structure and development, or wherein individuals agree one with another but differ from other fishes ; and (2) the *physiological* or such as pertain to function, as whether the forms under consideration are normally capable of fertile union one with another (but not so with those of other groups), being all descendants of a primitive race of ancestors. A *variety* is one which differs in some characters from the type of the species, but between which a distinct intermediate gradation has been observed. While a *local* race may be also a variety but wherein no such connecting chain has yet been discovered. What some consider a variety others would deem a local race or sub-species; thus a permanence of variation has been held to constitute a species, but its instability a variety.

Irrespective of the foregoing there are other forms of variation ; thus larval fish as the *Leptocephalus* (vol. ii, page 239), or young of the conger and some other fishes, may have their development arrested, in which condition they may still live for a longer or shorter period. *Monstrosities* are generally the result of some abnormal condition of the embryo, sometimes

occasioned by shocks or injuries when fission may ensue occasioning double-headed monsters; or crossing two distinct species would seem to set up various abnormal structural results. *Analogous* variation, or where an animal varies towards some allied form, has not, I believe, been observed in fish. There is also *atavism*, or the reversion towards the original type.

In addition to zoological classification, fishes are likewise divisible in accordance with their distribution and habits; thus some may be termed sea or *marine* forms, while others are *fresh-water* residents. Also there are species which observe no such undeviating peculiarities, as they are observed to roam from one of these localities to the other, especially such as are generally found in brackish water.

Marine forms are likewise subdivided in accordance with the areas they principally frequent; thus inhabitants of the open sea are known as *pelagic:* such as enter fresh waters for breeding purposes as *anadromous:* while the along-shore forms which are restricted within a tract up to 80 or 100 fathoms, rarely entering fresh waters or being found in mid-ocean, as *littoral.**

Fresh-water forms are those which pass their entire lives in fresh waters; while such as live in fresh waters, but descend to the salt water to breed, are termed *catadromous.*

If we now attempt further divisions, commencing with marine forms, a difficulty meets us so soon as we try to classify the various sea-fishes into residents of certain zones of depth, the majority changing their feeding-ground at different periods of their existence. They may also be influenced directly by heat and cold, sunshine and darkness, storms and calms; or indirectly by how these influences affect the products on which they feed. Thus occasionally pelagic forms are observed in vast numbers at the surface, where as a rule they are generally absent. The young also of many pelagic forms pass their infantile life in the littoral zone, but when adult retire into deeper waters. The Antennarius is found in some portions of the globe, living near the surface in its early age, revelling in the pleasures of light and warmth; but as time creeps on, some have been observed to sink to the bottom, where they can indulge at their ease in a sluggish existence, if it can be a pleasure to them to live where seasons are absent, and day and night unknown. The deep sea forms of animal life are observed to be mainly composed of more or less modern shallow-water genera, and their allies, which have extended their range into the deep sea zone.

In spite of the foregoing difficulties further subdivisions of fish have been instituted, thus in marine forms we have such as inhabit regions through

* A. Agassiz considers the *littoral* zone as up to 100 or 150 fathoms, or an extension of the coast-line to a depth at which the direct action of the sun's rays is limited: that from it in a slope up to 450 or 500 fathoms is a *continental* zone where the diminution of temperature is rapid; beyond this is the *abyssal*, where there is a low temperature varying little from freezing-point.

which light penetrates more or less as in the littoral zone, where sea-weeds, corals and shells are found and which may be termed the fauna of light: whereas beyond this zone a region of darkness obtains. Pelagic species are normally observed to be more or less restricted to certain zones of depth or bathymetrical regions and are known as *surface, median* or *abyssal* forms. While fishes of the fresh-waters are found frequenting rivers or *fluviatile* forms, or else passing their lives in lakes or ponds or *lacustrine* species: such as reside in large pieces of water may likewise select the shores and surface waters or the deeper portions of the lake.

GEOLOGICAL APPEARANCE.

Among the many interesting questions relating to fish, assuredly not the least so is when did they first appear in the waters of the globe which we inhabit? And for an answer we have to ask the Geologists, who assert that the lowest type of vertebrate life first occurred near the close of the Silurian epochs at the base of the Ludlow rocks, where certain spines, jaws, teeth and a cephalic buckler of probably a *Pteraspis*, as well as coprolite bodies containing crinoids and molluscs, have been obtained, but no other portions of true piscine skeleton. In the "Devonian" or "Old Red Sandstone," remains of fish in a more perfect state and in larger numbers are found, so much so that this strata has been termed the "age of fish." Some of the Silurian forms seem to have continued into the Devonian, and at this period ganoids and sharks became predominant but no trace of segmentation of the vertebra has been observed; ganoids and sharks are very abundant in the Carboniferous and Permian rocks which show the end of the Palæozoic epoch.

Up to the Mesozoic epoch fishes possessing heterocercal tails (page ix) were the ordinary type, but now they commenced to diminish, and the homocercal (page ix) form began to obtain predominance; in short, in the earliest times the posterior termination of the vertebral column was very similar to what we now find as an embryonic condition of teleosteans, persistent formerly, transitory now. The fishes in the Lias besides developing homocercal tails commence to show ossification and segmentation of the vertebræ, and *Leptolepis* a teleostean form, has been supposed to have been discovered. Among the fishes of the Oolitic strata a further advance towards the fauna of this period occurs, while rays become more numerous. In the chalk or cretaceous era, although Chondropterygians are found, it is the Teleosteans or bony forms, as already observed, that obtain predominance, and so on through the Tertiary period to our times.

It has been pointed out that had such fish as Cyclostomata or Leptocardii existed in Silurian or Mesozoic epochs it would hardly be expected that

they would have left any trace unless it were their horny teeth. Indeed specimens of such teeth or those of molluscs or annelids have been discovered in the Lower Silurian and Devonian strata.

Considerable difficulty has arisen as to whether the *ancestral forms** of fish were fresh-water or marine, and if the latter, whether they were first littoral, subsequently pelagic, or originally pelagic. At the present time, investigations tend to show that although marine species not infrequently enter, breed, and even take up their permanent abode in fresh waters, such is not the case with strictly fresh-water forms, which do not voluntarily enter the sea, or if there would succumb. True, a flood from a river or inundation along a coast may temporarily so alter the composition of the sea-water that a fresh-water form may reside in it or travel by it for some distance along a coast-line, but they die when the water becomes normally saline.

M. Agassiz, when giving some interesting observations on this question, remarked that although at present it is not plain that fluviatile types on the whole are superior to the marine ones, still among the higher forms of Chondropterygii as in ganoids, the bony pike, *Lepidosteus*, of America, the *Polypterus* of tropical Africa, the *Lepidosiren* or *Protopterus* of the west coast of Africa, and the *Ceratodus* of Queensland, are restricted to fresh waters. While even in groups considered to be marine the fresh-water forms possess characters generally denoting their superiority over their marine representatives.

DIFFUSION OF FISHES.

Fishes may have been dispersed over the surface of the globe in several ways, as marine ones through the ocean, and fresh-water species along rivers and watersheds, and in exceptional instances along coasts. For similarly to other forms of life they possess a natural tendency to increase as well as disperse when not checked by climatic or physical difficulties, or other external causes. As assisting in this diffusion there are uncertain agencies which can only act occasionally, but by means of which fresh-water forms may be dispersed, such as floods carrying them from one watershed into another, which although contiguous at their sources may lead in entirely different directions. In some species it has been shown that if fecundated eggs, as of trout, are kept moist and cold they can be conveyed in safety for long distances (page lxvii), while salmonoid eggs removed from the maw of a trout have been hatched. This renders it not improbable that should a

* In embryo-fish the developmental changes when correctly ascertained are a guide to the classification of the species.

hawk or eagle have secured such a fish and carried it away to the mountains in order to feed its young or consume it at its leisure, should the eggs fall into water they might similarly hatch and the breed spread. Geese and ducks (or even flying insects, as some beetles) might likewise spread fishes or convey the ova partially frozen attached to their bills or feet, while it has been suggested that they might likewise be conveyed among the wet feathers of birds or the fur of otters.* Among such forms as the perch, wherein we see stringy ova, such might be carried long distances attached to sticks or grass or even to the feet of herons, grebes, &c. McCleay (Proc. Linn. Soc. N. S. W., iii, p. 15) notices how a marine fish, *Therapon unicolor*, had been found in a dam near Warialda, to which place the ova was supposed to have been conveyed by birds: Davy also suggests that glaciers may have assisted in the dissemination of ova.†

DISPERSION AND DISTRIBUTION OF FISHES.

That *marine fishes may become temporary or permanent occupants of fresh waters and so change their condition of life* has been observed by fish culturists for centuries. Anadromous forms as the salmon ascend into fresh waters to breed, there its eggs are hatched and the young reside until sufficiently mature to follow their parents' mode of life. Should the return of marine species to the sea be prevented, this is not necessarily fatal, for the form may take on a fresh-water life. In the tropics it is common to find true marine fishes in pieces of fresh water not far removed from tidal influence, due to their having entered these places while the monsoon rains were at their height, the rivers and swamps full, when they had become carried, perhaps by a high spring-tide, over a bank, but as the waters fell they became imprisoned in their new situation and unable to return to the sea. Similarly sea-fishes rove into our fresh waters after food, conclusively proving that such change does not necessarily occasion their death, while here they may remain and continue their race as observed in the northern portion of the Baltic (i, page 54).

In India, marine fishes are frequently observed ascending rivers for predaceous purposes as far as the tide extends or even further. *Therapons* are not uncommon in the Hooghly near Calcutta, while I have taken a sea-perch, the "cock-up," *Lates calcarifer*, as far inland as in the river at Pegu

* Pontoppidan (Natural History of Norway, ii, p. 139) remarked that at the top of Varne-set and many other high places in Haranger, fish are taken in ponds which have no communication with [illegible] prey have carried the spawn or young fry up there.

† Dr. Stoliczka found fishes living in Tibet in fresh water 16,000 feet above the level of the sea.

in Burma, and a species of saw-fish, *Pristis Perrotteti*, upwards of four feet long, in the Mahanuddi river in Orissa, in fresh water and at least forty miles from the sea. M. de La Gironnière found a saw-fish inhabiting fresh waters in the Laguna de Baij, Luzon, and which was identical with those in the Gulf of Manilla. Gill has observed upon a saw-fish and a shark being taken in Lake Nicaragua. Advantage has been taken of the knowledge of how marine forms will live in fresh water, and the Romans turned it to a practical account by forming fresh-water vivaria wherein some marine fishes were kept. Mr. Arnold has been similarly successful in Guernsey (vol. i, page 229), and Colonel Meynell in Yorkshire (vol. ii, page 123).

The *intolerance of fresh-water fishes to sea-water** is greater than of marine ones to fresh. Such forms as perches or sticklebacks, whose ancestors were probably marine, are more tolerant of saline water than the more strictly fresh-water species as carps. This question, of course, is most important as regards the dispersion of these forms, for should they not be able to live in anything but fresh water, for them to extend from one point to another practically requires a land connection. Lubbock tells us that on sea-floods occurring in the Norfolk Broads, the first fish to suffer are the tench, pike, bream, and roach; perch bear a strong admixture, but catadromous eels are unaffected. If, as is the case in Oceanic Islands, as the Andamans of the Indian seas, we find fresh-water fishes similar to those on the mainland and at Ceylon, it seems reasonable to suppose that although the two localities may be hundreds of miles distant, a land connection must have existed between them at some antecedent period of the world's history. If volcanic islands are searched true fresh-water fishes are absent, unless they have obtained access by accident, or been placed there by man. Respecting the northern limits of fresh-water fishes it has been ascertained that they are absent from regions where ice is nearly or quite continuous.

Abyssal forms (see page lxxxi) are found in the deep abysses of the ocean, where there is an entire absence of light obtained from the surface, but whether there are not present means for the production of luminosity I have already touched upon (page xxv). Deep-sea fishes have either very large eyes, similar to nocturnal land animals, or else they are quite blind, and as regards these organs they show a considerable resemblance to what is observed in such as inhabit waters in dark caverns. Recent investigations would seem to show that from eighty or a hundred fathoms in depth up to two hundred fathoms the size of this organ increases, in order to collect any rays of light, but beyond this last depth both large and small eyes are found; the latter forms have also usually tentacles, for the purpose of feeling,

* As bearing on this point, marine *Medusæ* are very intolerant of fresh water, but a fresh-water form having been discovered, it was found to be even more intolerant of sea-water than the marine ones are of fresh (*Nature*, June 24th, 1880).

whereas at the most profound depths both eyes and tactile organs are absent. Deep-sea forms are either pale, colourless, or of a single tint; and as already remarked (page xiv), the tissues which connect their hard structures together are weak; while such as are brought up from great depths have their bodies expanded, and even burst, due to the removal of the pressure of superincumbent water, as has been observed (page xliii).

The temperature of the sea at 500 fathoms is as low as 40° F., even under the equator in the Atlantic and Pacific Oceans; below 2000 fathoms it is not more than a few degrees above freezing-point, except in peculiar instances of land-locked seas. Almost everywhere at 500 fathoms, and everywhere at 1000, there is nearly an absence of currents, and movements must be very slow and probably quite imperceptible to the resident animals; as a consequence of this similar condition of life the deep-sea fauna show no zones of distribution in depths below 500 fathoms.

M. Regnard has made experiments with water respecting the amount of pressure a fish will sustain: one destitute of an air-bladder, or in which it had been evacuated, he found might be submitted to a pressure of 100 atmospheres, equivalent to a depth of 650 fathoms, without injurious effects; at 200 atmospheres it became torpid, but soon recovered on being removed; at 300 atmospheres, equivalent to about 2000 fathoms, it died. But among other reasons for failure in this last experiment, the pressure was more rapidly induced than would occur in nature, were a fish to change its habitat.

Some abyssal forms are dwarfed, perhaps from cold or deficiency of food; others, perhaps due to absence of foes, are almost gigantic.

Many deep-sea forms have an enormous development of the mouth and stomach, thus enabling them to swallow fishes even larger than themselves, probably in order to retain a stock of food sufficient for some time, all being carnivorous, for at certain depths Pteropods dissolve, at greater distances the Globegerina are similarly lost, possibly the sea-water itself assisting, as when alkaline it can absorb an additional amount of carbonate of lime. Doubtless oxygen decreases with depth of water, but some is present even in the deepest.

The number of animals in the sea decrease as the depth increases, and in the deep abysses a varied repast sinks from the surface; while as no plants, unless parasitic, are found, all food must descend from above, assisted by shore debris and vegetable matter carried down by rivers and which reach the sea-bed.

Pelagic fishes (see page lxxx) are more numerous in tropical regions than in our own, and not a few are cosmopolitan, while they often follow their food into the littoral zone. Some are rapid swimmers and pursue their

prey, while others, as the *Antennarius*, drift about on sticks or seaweed in accordance with the action of winds and currents. Among them are some which ascend to the surface during the night-time, and may be possessed of luminous organs (page xxv), common to them, and likewise to some of the deeper abyssal species.

Littoral forms (see page lxxx), although constantly migrating within the limits of their own zone, or even extending their range to within the localities frequented by pelagic species, will often decline to pass deep-sea ravines to opposite banks, or cross over ledges of rock.

GEOGRAPHICAL DISTRIBUTION OF BRITISH FORMS.

Among the nineteen genera of fresh-water fishes which inhabit the British Isles, the following are, (I) common to the Palæarctic and Nearctic regions: 1. *Gasterosteus*, 2. *Perca*, 3. *Cottus*, 4. *Lota*, 5. *Salmo*, 6. *Thymallus*, 7. *Coregonus*, 8. *Esox*, 9. *Leuciscus*, 10. *Abramis*, 11. *Sturio;* (II) forms restricted to the Palæarctic region: 12. *Acerina*, 13. *Gobio*, 14. *Tinca*, 15. *Abramis*, 16. *Alburnus;* (III) genera present in the Palæarctic and Oriental regions: 17. *Cyprinus*, 18. *Carassius*, 19. *Nemacheilus;* (IV) found in the Palæarctic, Oriental, and Æthiopian regions: 20. *Barbus*.

Among the foregoing, eleven, or more than half of the British fresh-water genera of fishes, are common to both Arctic regions, while those numbered 1, 3, 5, and 7 have marine representatives. Nos. 2 and 11 are frequently found in salt water, the former being closely connected with the marine perches, and *Lota*, possibly the remnant of a glacial ocean, is closely related to marine forms; but *Leuciscus*, *Abramis*, and *Esox* are distinctly restricted to fresh waters, yet are found in both regions, whereas the sea as at present existing would form an insuperable barrier against their normal extension from one point to the other. It has been advanced that all evidence points to a continued mild climate in the Arctic regions through Cretaceous, Eocene, and Miocene times, whereas had the North Atlantic between Europe and North America been closed, although such might have raised the temperature of these isles, it must have increased the cold in the Arctic regions by cutting off the gulf stream. Appearances, as regards the distribution of mammals, seem to point to there having been probably on more than one occasion, but for brief periods during the tertiary period, a land connection between N.W. Europe and N.E. America, and to this the distribution of the strictly fresh-water genera of fish would seem to lend countenance.

Cyprinus and *Carassius* appear to have been forms introduced into our isles, while the little loach *Nemacheilus* is found in a continuous chain of many species throughout the Palæarctic and Oriental regions.

We have now to consider whether fresh-water fishes in their distribution lend any countenance to the theory that Ireland was formerly united to continental Europe; also that a great portion of Great Britain became submerged, but a re-elevation of land occurred; and finally that Ireland was separated from Great Britain, and subsequently the Straits of Dover opened.

Among the nineteen British *genera* thirteen are present in Ireland: *Lota*, *Barbus*, and *Alburnus*, local in England and unknown in Scotland, are absent from Ireland; so likewise are the local races of *Thymallus*, introduced north of the Tweed during recent years, while the only recorded *Acerina* in Scotland, is one specimen said to have been obtained off Troup Head in Banffshire, possibly an error. Leaving our common bull-head, *Cottus*, as an absentee from Ireland, where, however, Yarrell believed it to be found: Wallace's contention that the distribution of the *species* of our Salmonidæ confirms the view that the races of fresh-water fish in Ireland differ from those in Britain, is founded on two mistakes: first, he considers varieties as species; secondly, even were they species, he mis-states where they are found. If, however, we turn to the *Leucisci*, we do find the roach, *L. rutilus*, the chub, *L. cephalus*, and the dace, *L. vulgaris*, to be absent from Ireland, and also more or less from Scotland unless introduced. Fresh-water fishes, while they do not refute the disseverance of Ireland from Great Britain previous to the division of the latter from continental Europe, do not add any material confirmation to the statement.

Respecting the geographical distribution* of our marine forms, I have alluded to it when describing the families and genera, and consequently shall limit my remarks first as to whether similar species exist in distant regions of the globe, and secondly, how they disperse. M. Valenciennes, in 1824 ("Mem. du Mus.," xi, p. 265), drew attention to the great resemblance that existed between the fishes inhabiting the Mediterranean and those of the seas of South Africa; while Dr. Keller has ascertained

* Errors in the geographical distribution of species are not infrequently due to insufficient care having been exercised in testing the accuracy of statements as to from whence the specimen had been obtained. An example of sucking-fish (*Echeneis*) was sent me in a bottle of spirits as having been trawled at the Nore in May, 1880, which was so far correct that it had been thus taken, bottle and all. It is easy to perceive how accidents might occur trawling such examples as the one I now record. Had the bottle been broken and a sucking-fish found in a trawl at the mouth of the Thames, it might have obtained access into a local collection, and when the species became recognized it would most truly have been asserted to have been captured at Southend. Turton has assured us respecting the North American bony pike (*Lepidosteus osseus*), that "it is rarely found on the Sussex coast," probably because Berkenhout, in his "Outlines of Natural History," records one two feet long: also Stewart ("Elements," i, page 374) has remarked upon its occurrence in the Frith of Forth. If these specimens were received they may have come from a wreck, or were perhaps thrown overboard by a passenger or sailor. Even in 1880 the tropical *Holacanthus tricolor* was erroneously asserted by Dr. Günther to have been obtained at the Island of Lewes (vol. i, p. 41).

that eleven species of fishes from the Mediterranean have penetrated *viâ* the Suez Canal into the Red Sea, and twenty-five have reached at least half-way from the Red Sea through the same canal.

The following species identical with British forms have been taken in the seas of Australia, but not in the intermediate intertropical region:—*Caranx trachurus, Zeus faber, Sciæna aquila, Argentina sphyræna, Engraulis encrasicholus* (variety), *Clupea sprattus, Conger vulgaris, Orthagoriscus mola, Galeus canis, Acanthias vulgaris* (variety), *Echinorhinus spinosus, Rhina squatina.*

It has been abundantly shown that fishes of colder climes do not unfrequently migrate towards warmer regions, but when doing so keep further out from shore in deeper waters and colder areas. Although it seems difficult to admit that fishes with a physoclistous form of air-bladder could migrate in the cold water under the tropical sea, and thus, as it were, reappear in the southern temperate ocean, still in nature we do see identical forms in these two widely separated places. But in their younger stage all fishes with air-bladders must have the connecting tube with the alimentary canal pervious, and it is not so difficult to consider that in some it might abnormally remain patent through life, giving them the same facility of evacuating it as seen in physostomous forms, while M. Regnard's experiments already alluded to (p. lxxxv) show what a large amount of pressure fishes will bear without fatal effect, while in nature they would gradually accommodate themselves to such changes.

MIGRATIONS AND FOOD.

Most fishes are subject to *migrations,* which are either seasonal, which is consequent upon climatic changes, or for the purpose of reaching a suitable spot for the continuation of their race (page lix), or diurnal or nocturnal, to obtain food for the nourishment of each individual. This latter is mostly dependent on temperature, certain conditions of the water, and the supply of sustenance. An irregular appearance of migratory shoals of marine forms, as the mackerel, anchovy, herring, pilchard, or sprat, may be consequent upon their pursuing some peculiarly abundant and desirable food, or else be caused by their having been alarmed by some undesirable enemy, for fear may cause shoals to vary their direction; while I have observed that in the Indian seas, when from any reason the sardines have remained away, voracious forms which prey upon them were likewise absent.

Temperature evidently exercises a considerable influence, and Baird

observes of the anadromous salmon, herring, and shad, of the United States of America, that their journeys are simply from the mouths of rivers by the nearest deep gully or trough to the outer sea, and that the appearance of the fish in the mouths of the rivers along the coast at successive intervals from early spring in the south to near midsummer in the north, is mostly due to their taking up their line of march at successive epochs from the open sea to the rivers they had left during a previous season, induced by the stimulus of a definite temperature, which, of course, would be successively obtained at later and later dates, as the distance northwards increased.

Having ascertained what minute forms or descriptions of life are sought out by migratory fish as *food*, it next becomes necessary to ascertain what it is that governs or controls their migrations, as currents, soils, temperature, atmospheric changes, or the existence of some still more minute food on which they themselves subsist; also what are their enemies or their friends, and the conditions which favour the presence or absence of either class. The surface of the ocean everywhere teems to a greater or less extent with animal life, but this cannot subsist without a vegetable basis, both being very susceptible to atmospheric vicissitudes.

When desirous of investigating what constitutes the food of fishes,* it soon becomes evident that the inquiry branches off in many directions as to whether the fishes are marine or fresh-water, and what districts (page lxxx) they chiefly frequent: and as researches are extended, the nutriment consumed by the young in their different stages until maturity is attained. While the fish culturist† and observer will have to find out and ascertain what are the influences which assist in developing the food or act injuriously upon its growth or distribution. Augmenting the numbers of fish in pieces of water is often undesirable without having previously ascertained whether a sufficient amount of food would be present for their wants.

Among fishes, although we have predaceous, herbivorous, and omnivorous species, there are few which will not prey upon any animal less powerful than themselves, while marine forms are said to be able to withstand hunger longer than those of the fresh waters. The majority of forms feed during the day-time, although some prefer the earlier morning or the evening hours; others again, as the *Liparis*, would seem to forage about at night-time. The sucking-fish, *Echeneis* (page lxxvii), uses its host as a means of conveyance from place to place, so that it can change its locality: while the myxine consumes its host; and the electric ray (lxxvi) takes its prey by means

* See "Food of Fishes," Fishery Conference Papers, F. Day, 1883.
† See "Fish Culture," F. Day, 1883.

of shocks. Under the head of each species I have endeavoured to give an account of the food each is most partial to. While in captivity some fish eat what they reject or are unaccustomed to when in a state of nature: some forms in aquaria will consume, if they can obtain it, more than is wholesome for them.

If we look at a newly-hatched fish we see a large sac or the yelk—or umbilical-sac dependent from its throat, in it nourishment is contained on which it has to subsist for a longer or shorter period, and when absorbed it must seek food for itself, and this in the period when the fish culturist finds it so difficult to procure suitable diet for his small charges.

Around our coasts are distributed various kinds of sea-weeds, thus where the bottom is rocky we find brown algæ (*Fuci*), and further out the red form (*Floridi*). But, as already observed, with increasing depth vegetation becomes less, or should sea-weeds drift to sea, they subside and constitute soft black mud, wherein worms, molluscs, crustaceans and other marine animals have their home and find their subsistence, while they in turn form food for fish. Professor Mobius (Die Nahrung der Seetiere) at 90 to 95 fathoms in the Baltic, where the bottom consisted of plastic clay, found very few worms: in the Mediterranean, south-east of Sicily, at 1700 fathoms, where the bottom consists of yellowish clay, the British exploring expedition found no traces of animal life. But in the southern parts of the North Sea, at 20 to 25 fathoms, and with a muddy bottom, such is found to be alive with small crustaceans, worms, snails, molluscs, and echinoderms, and as a result with fish which live there and prey upon them. Irrespective of the foregoing vegetable substances, floating sea algæ, which form food to marine animals, and sometimes microscopic forms are so numerous as to render the surface almost turbid. Diatoms live in every sea, and are consumed by pelagic animals, as Salpæ and Pteropods. Likewise all rivers carry organic matter into the ocean, rendering the bottom rich and a resort for the invertebrate animals, as well as the fish which prey upon them; while currents which carry plants and small marine creatures from place to place must likewise influence the migration of fishes. In short, the temperature, saltness, purity of the water, currents and depth of the sea must each and all exercise a great influence upon animal and vegetable life, also the character of the neighbouring shore, as regards its geological formation and whether fertile or barren, rocky or sandy, and the amount of surface drainage which flows into it.

The food consumed by fresh-water forms has been more closely investigated than among marine species, and it is only by knowledge of what is required, combined with care and constant attention in carrying such out, that private fish-pond culture can be made profitable. Leaving them

to nature and withdrawing control is almost as ruinous as if arable lands were to be left to be self-sown: while want of food may be occasioned by too large a population of small and inferior sorts which starve the remainder.

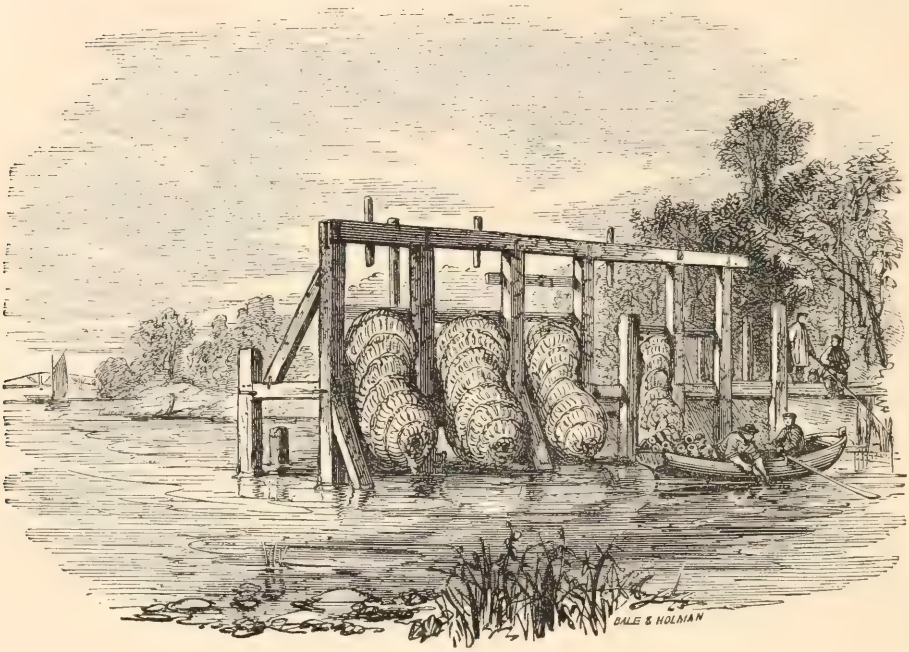
During cold months, also during the breeding season, a cessation in taking food may occur in some forms (page lx), but during such periods as they are on the feed they may obtain it from the bottom or soil over which the water flows or is placed, from mid-water as substances which are washed down or subside from the surface, &c., or from the surface itself as flies or vegetable food.

Although the *growth of fish* is often irregular, as a general rule they do not alter their form to any very great extent from what they are when young to what obtains during mature life; still the comparative increase of certain parts to that of the entire animal may not continue the same. Thus, the relative size of the eye to that of the head decreases, the armature about the head may diminish or disappear, the form of the snout as seen in saw-fishes may change (plate lxix) as well as the character of the fins (page ix). While in some pelagic forms *Hemimetamorphosis* may occur, or very considerable alterations in their growth and development which have not infrequently occasioned misunderstanding as to the genus or even family to which the young individual belongs. More complete *metamorphosis* is observable in the lampern (vol. ii, p. 362), while the deciduous external gills of fœtal sharks, rays (plate clxv), and a few other fish, may almost be deemed to belong to this group.

Secondary sexual characters likewise induce changes. Thus, although the male salmon has a knob-like tubercle on the lower jaw, the young has none, but is similar to the female (page lvii). The skin may change, becoming more rough in one sex, and spines appear most developed during the breeding-season, as in the rays (vol. ii, p. 329). The teeth likewise may be different in adults of the two sexes. Other instances are alluded to in the following pages.

The size of some fish may increase more rapidly under certain conditions than it does in others; a few seem to bear confinement easily, and grow large when well fed in an aquarium. In the Southport Aquarium turbot received, 3 inches across in size, became in two years 10 lb. each in weight, and after two years more they further augmented to 20 lb. Many forms will live when in a contracted space of water without increasing in size. While degeneration in size may be owing to local causes, as want of sufficient nourishment, but be entirely distinct from degeneration in structure or function. In short, growth may greatly depend on the food which is obtainable, and which fish have usually to disperse and follow after,

in their turn becoming a prey to the larger species. As the eggs of marine invertebrates are deposited at the same time as those of many fishes, the fry of the latter find minute food (the young of the former) ready for their wants, so fine, indeed, that they are only obtained by straining the water through gill-rakers.



EEL-TRAPS.

BRITISH FISHERIES.

Our fisheries afford employment to various manufacturers, traders, and fishermen, but their immediate uses are variously regarded by different classes, the fishermen chiefly concerning themselves with what they can obtain at the present time, regardless of future years' supply. The public mainly interest themselves in the cost of the article when brought to market, while the Economist bases his conclusions respecting their value in accordance with their reputed produce, or should the supply be unable to meet the demand, he unhesitatingly advocates the use of more destructive agencies under the belief that the sea is inexhaustible, and augmented captures are equivalent to increased productiveness! But it may be asked, is the sea, if the stock is not artificially replenished, inexhaustible; is it a fact that what man removes from the ocean is but an infinitesimal quantity to what is consumed by birds and the numerous other enemies of the finny tribes?

In order to ascertain if fish are increasing in numbers, decreasing, or whether the supply is stationary, investigations ought to be continuously, systematically and impartially made into the size of those captured (omitting such as pertain to migratory shoals), and if such is augmenting or lessening, also is their condition better or worse than it was? Should investigations lead to the belief that fisheries are being unduly depleted, it ought to be noted in what families of fish this is occurring, as well as the reputed cause, while in marine forms it is necessary to investigate whether the fishermen have to go further out to sea to obtain their captures than was formerly the case, if the killing power of the nets has been increased, and whether more men are now required to obtain the same amount of fish than was the case a few years previously. If we refer to former times, we find the inshore fisheries were very productive, similar to those of every other country sparsely inhabited by man, but as years went on and the population augmented, an increased supply of fish became a necessity. Man brought into use more killing methods, and in every part of the globe this has been followed by a diminished inshore supply. Almost everywhere we hear of the decline of our inshore fisheries, and the consequent imperative increase in size of our trawlers, and, although the price of fish has largely advanced, they are compelled to go further out to sea to obtain remunerative captures. It appears, unless we disbelieve the evidence from most localities around our coast, that inshore fishing is becoming comparatively unremunerative, and many assert that this commenced at the same period that trawling became more common, and the regulations for sea-fisheries were abolished.

For the purpose of arriving at conclusions respecting the condition of the sea-fisheries, it would be well to briefly consider of what do the more important classes of fish used as food consist? It must be evident that what would benefit sharks and dog-fishes might be inimical to herrings; cod-fishes might be deleteriously affected by what would be harmless to sprats and mackerel: while our soles and flat-fishes might be entirely destroyed without such doing any damage to the wrasses. Although it seems improbable that any species of sea-fish could be exterminated by man, it is certainly a fact that he is able to annihilate a fishery or drive the fish away from where he can capture them, which has the same effect on the cost of the article.

Our markets are largely supplied with sea-fish from three principal classes: (1) such as come in large assemblages or shoals, as the mackerel, herring, pilchard, and sprat, and which may be considered, as a rule, to be surface swimmers; (2) mid-water and bottom-feeders in the littoral zone, as the cod, haddock, and their allies, which are predaceous in their habits; (3) ground-fish, as soles, turbot, and other flat-fishes. One of these classes being in a satisfactory state does not necessarily prove that all the others are. If the cod-fishes were exterminated, this would remove one more of the enemies from the herrings, and might in fact be conducive to their increase.

Herrings may be scared away from a district by several causes,* and have been known to absent themselves for years, perhaps the surface food which they consume may have been deficient in quantity, or even absent; or they may be driven further out to sea, and breed there, resulting in the young taking on deep-sea proclivities, and probably forming a deep-sea race. If these shoals no longer frequent the shores, the amount of excrementitious deposit which would fall from them would be lost to the invertebrate forms which subsist in such places. Irrespective of this, herrings off the east coast of Scotland being now further out to sea than was the case a few years since, larger boats have to be employed by fishermen, while there is no harbour accommodation for them; consequently storms are more fatal than formerly. It is to be regretted that our Fishery Inspectors do not yearly collect general fishery statistics for the United Kingdom; there are no means of finding out whether coarser kinds are, or are not, taking the place of the better sorts in our markets; soles may be as abundant in regard to numbers in 1883 as in 1882, but it would be desirable to know if their size has augmented or diminished.

It has been said that doing away with fishery laws has been purposely effected in order that sea-fisheries should be left to man, to work them

* Star-fishes have increased enormously along the American shores, due to herrings and other fishes, which feed on their spawn, having deserted the inshore ground.

according to his individual caprice, untrammelled by any restrictive enactments, as such only tend to upset the "balance of Nature." While protection, it is asserted, is only necessary when the habits of any fish compel it to live throughout the year in a confined area to which man has access, or to pass once or more in any year into some narrow space commanded or capable of being commanded by man. But it seems to have been overlooked that man, left to fish as he likes, when he likes and where he likes, does not act impartially in fisheries. He does not destroy every form indiscriminately, thus maintaining "a balance," but merely such classes as he desires for food. The mackerel and the herring are taken in millions, but the shark, the dog-fish and the porpoise are practically left unmolested, and in this way any balance would not be "maintained" but "upset." The haddock and cod are being destroyed to an enormous extent, and appear as a consequence to be decreasing, both in size and quantity: this again may tend to deprive gregarious fishes of one of their natural enemies. The mussels, crabs, and other invertebrates, which form the food of the inshore fish, being unprotected, are diminishing around our coasts, and this due to the action of man, for when protection has been afforded, as off the coast of Norfolk, a great increase almost immediately took place.

Our markets are supplied from two distinct economic divisions of fisheries; the first, such as crabs, lobsters, and eels, wherein a foreign supply keeps the price down, and consequently the fishermen would have to preserve these fisheries in a tolerably fair condition, or else, with prices restricted to a certain maximum amount, they would be unable to supply the markets. The second class, or mainly fresh fish, cannot as a rule be furnished from abroad, consequently the price will rise or fall with the supply. If the supply is small the fisherman receives a commensurate augmentation in money—he is no loser, it does not signify to him if the market has an insufficient amount. Or if quantity is required, still that the better class of fisheries are impoverished is of as little concern—he can fill up with inferior sorts, such as a few years since were rarely seen in our markets. The importance of *fresh-water fisheries* is not solely in a ratio as regards the amount of their productiveness, but also in accordance with the character of the contiguous people, as to whether they are fish-consumers or reject such an article of diet: the sparseness or the reverse of the population, and facilities for transport to distant places. Where no regulations exist for the protection of inland fisheries, and should other circumstances be equal, that country or district which is most densely populated by man will be least so by fish. Individuals would rather live by fishing than by agriculture, because the trouble of capturing the finny tribes is less than that of tilling the soil. It becomes simply a matter of catching food without a thought of future supply. As, however, the human inhabitants augment, watery wastes

(wherein fishes were previously protected by grass, reeds, or trees) become drained and cultivated, and predaceous man increases his modes of destruction.

Respecting our present fresh-water fisheries, that of the salmon is the most valuable (vol. ii, page 70), but it almost seems as if our legislators are being misled, and therefore ignore the axiom that the good of the fish and fisheries should be of greater consideration than the interests of private individuals. A free passage for the fish* to their breeding-grounds and an unpolluted river are certainly necessities for an abundant supply, and although poaching does injury, such is a mere fraction in the element of destruction compared with the battle for life in the lower waters, which is a far more efficient reason for the paucity of fish, whether such is owing to legalized fixed engines, or an excess of netting in the lower reaches or along the tidal shores.

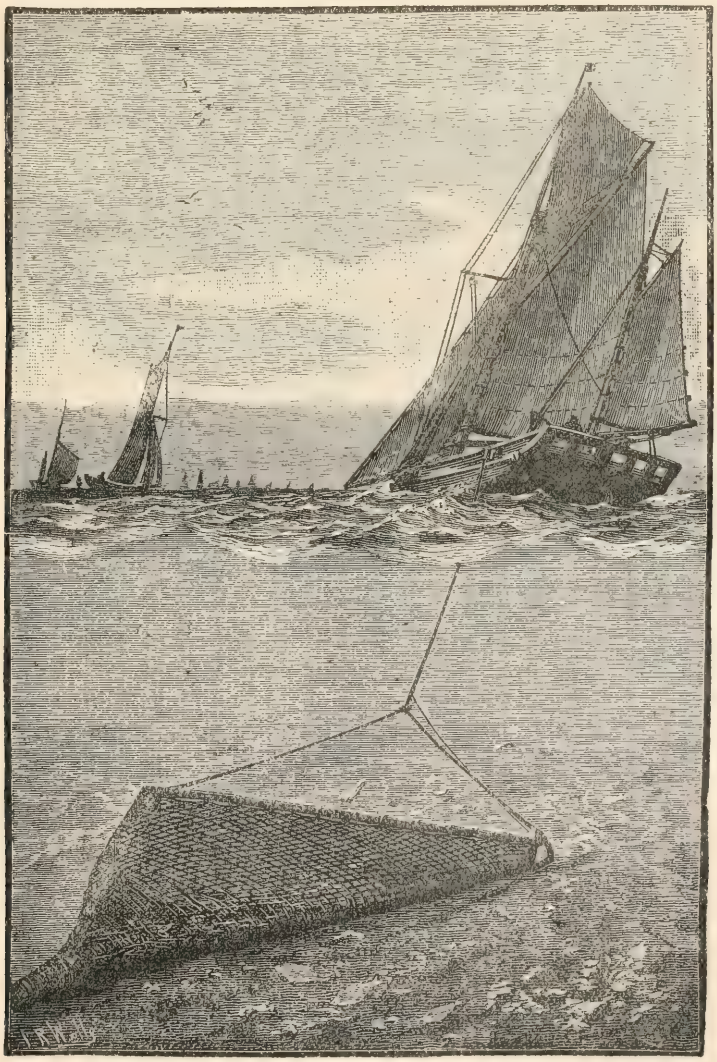
MODES OF FISHING.

Possibly the most primitive mode of tidal fishing was the construction of pounds or enclosures into which fish entered with the flood, but were left impounded at the ebb. Here they would be removed by hand, spears, or by a small net. In some places it may have been found necessary to erect a rough wall across the outlet which would permit water to escape but detain the large fish, or a trap might be inserted at this spot. Advancing still further are wicker-work labyrinths, and next stake-nets, made on various plans. In the late "Great International Fisheries Exhibition," these various modes of fishing from India were shown in a consecutive series: † dip-nets were seen in frames, or used as purse or lave-nets, so that they can be dragged or pushed up narrow pieces of water, or a row of fishermen can employ them along the coast. If these purse-nets are taken from their frames, and have their free extremities weighted by sinkers, we obtain the cast-net; or connect several of these cast-nets together, when it is desired to drag a piece of water with them, and we have a sort of ground-seine. Then we have set-nets or trammels, seines employed in bays, and finally drift-nets for outside fishing in order to capture surface forms. It is not my purpose to follow out the various descriptions of nets, traps, and appliances that have been used for the capture of fish, but merely to briefly allude to the principal modes of fishing as now carried on in the British Isles for commercial purposes, and they may be classed under nets, fixed engines, and hooks-and-lines.

* The abolition of night netting in rivers, a longer weekly close time, and the prohibition of all fishing within 150 yards of fish passes, would be highly desirable for the above object.

† See "Catalogue of the Exhibits in the Indian Section," by Francis Day, page 6.

The Beam-Trawl is in very considerable and still increasing use around the British coasts for the purpose of obtaining ground-fish of prime commercial importance, as turbot, soles, and brill, as well as for capturing inferior sorts, as gurnards, haddock, whiting, plaice, skates, and rays. Sailing boats can be employed when a sufficiency of wind exists, for it is necessary to go rather faster than the tide, but steam-trawlers have the advantage of being independent of the necessity for wind in working their vessels. The rapid advance in beam-trawling during the last fifty years has been greatly assisted by the introduction of steam, ice, and railways, thus not only enabling more of the finny tribes to be captured, but likewise



BEAM-TRAWLING.

their being conveyed more rapidly to the shore, kept fresh for a long period, as well as being readily distributed through a wide expanse of country.

We possess two classes of trawlers,* the beam-trawlers that fish the sea either singly or more commonly in fleets (at least for the last 25 or 30 years); and the inshore-trawlers which are employed in bays and shallow waters where they rarely work in companies.

The beam-trawl† is a purse-shaped net of a triangular shape, sometimes as much as 100 feet long, along the upper edge of the mouth of which is fastened a horizontal beam, from about 25 to 50 feet in length; this beam is kept off the ground by means of two iron heads, so that merely the under portion of the net and the ground rope touch the bottom of the sea when it is being towed along by the trawler: it is usually employed over a muddy or sandy bottom: but lately steam ones have used them over rough ground along our south coast.

The under portion of the net which touches the ground is subject to friction, and so much so, that various kinds of chafing-pieces have to be added to prevent its giving way, while the amount of pressure inside the net when being towed is so great as to cause a resistance sufficient to reduce the speed of the trawlers from perhaps eight to one knot. The consequence is that fish inside this bag-net become more or less bruised from violence. We are told by theorists that the trawl by pressure can do no injury to young fish, but one would imagine that a net that requires a hide along its under surface, and containing some ton or more of contents, must do injury if scraped along over young and delicate flat-fishes as well as tear up and destroy sea-weeds where the eggs of herrings and invertebrates are deposited (page xcii).

Mr. Ansell asserts that when the "silver pits" in the North Sea were first worked (1878-79), a trawler got a ton to a ton and a half of soles in one night, of from £12 to £24 value. Now, although the wholesale price has increased, the take has so diminished that trawlers have to seek fresh ground. While Mr. Sim remarks that although in his opinion there are as many soles caught now as fifty years since, they are about one-fiftieth part of their weight. At Yarmouth beach you can see the men picking out small immature fish—soles half as long as a finger, and turbot, so to speak, not larger than a thumb-nail. It was no use throwing them overboard, because, after they once got into the net, they died.

Our inshore bays and banks at sea are the chief nurseries of our flat-fishes, and of many other forms which are taken by trawls; in fact most, if not

* I omit otter-trawls as they are not largely used by the fishing trade: also the complaints of line and drift fishermen that much damage is done to their industry by beam-trawlers.

† The Scotch herring trawl is the English seine (see page c): the American trawl is a long line with baited hooks.

all, forms of sea-fishes pass a portion of their infantine existence where the waters are shallow. If the bays and tidal harbours of our south coast are searched in May and June, millions of these small fry may be found. Mr. Ansell considers that although by trawling much harm has been done by destroying young fry, greater damage has been effected by the small boats which trawl for shrimps in our bays and estuaries. The mesh of the nets of these trawls is so fine that nothing escapes, and thousands of bushels of fry are annually slaughtered by these craft.

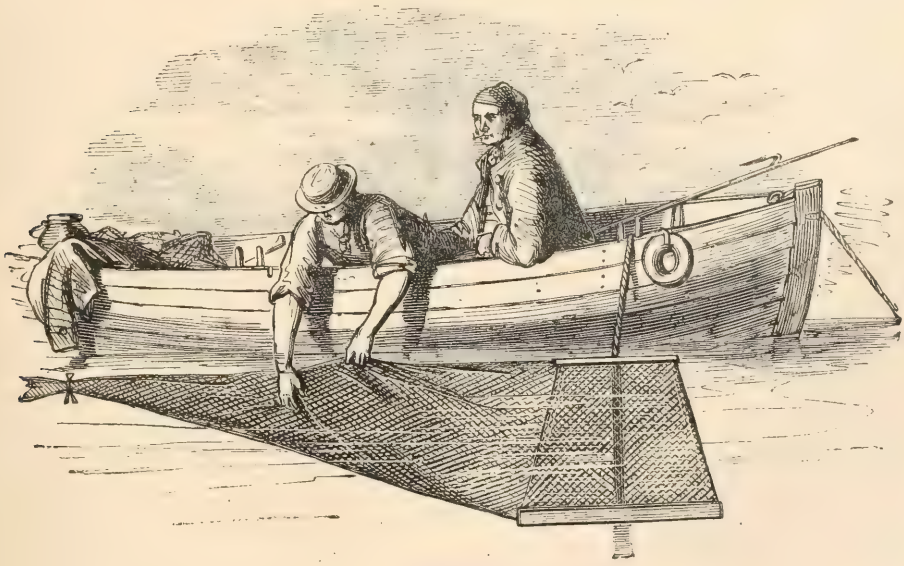
If, as we are assured is the case, fish, as the sole, has not augmented in price more than other articles of consumption since the abolition of fishery regulations, surely market returns would form a good basis on which to argue. Her Majesty's Commissioners gave us the daily cost at Manchester of soles during ten years ending 1865, restricting their figures to the month of January, and showing the retail cost per pound. I have similarly treated figures from Birmingham, and find if these periods are divided into five years each, that prior to the abrogation of sea-fishery regulations soles cost per lb. :—

5 years ending 1860 lowest cost 3*d*, highest cost 8*d*, mean under 6*d* lb.
" " 1865 " 6*d*, " 10*d*, " 8*d* lb.

Subsequent to the abrogation of sea-fishery regulations soles per lb. at Birmingham cost :—

5 years ending 1878 lowest cost $3\frac{3}{4}d$, highest cost $18\frac{1}{2}d$, mean under 13*d* lb.
" " 1883 " $6\frac{3}{4}d$, " 30*d* " 18*d* lb.

We are told that unless a close time for all fishes is imposed generally no good will ensue. This is an erroneous statement: certain well-known



STOW-NET.

breeding banks or bays might be selected by local authorities and closed during specified seasons from trawlers. Also it is very questionable if trawling within the three-miles limit might not be prohibited with advantage.

The *stow-net* is employed in various places, as the mouth of the Thames, and is useful in taking sprats and whitebait (see vol. ii, p. 232). Moored in a suitable locality at the commencement of a tide, the shoals are carried in by the current, but as the tide slackens the net is lifted.

The *lave-net* as used in the Severn and contiguous pieces of tidal water is very destructive to salmon. A line of boats is anchored across a certain spot, and a large lave-net resembling an enormous landing-net with a triangular mouth and a long handle is let over the side of each boat with its entrance towards the incoming tide. The bag of the net is of sufficient length to be brought under the boat and is loosely held in this position by the fisherman on the up river-side. On a salmon striking this lave-net in his course, the bag end is at once let go, and the lave-net side facing the incoming tide is elevated, the gunnel of the boat acting as a rest for the handle to be worked like a lever.

*Seine or sean nets,** also known as "sweep- or draught-nets," or in Scotland as "circle-nets" or "trawls," are of varying length and meshes, but their essential use is to enclose a space by either their two ends being dragged on shore, or brought close together if fishing at sea. These nets are formed of two "wings" or "sleeves," one on either side, while the centre portion, known as the "bunt" or bag, is much the deepest part, and consequently forms a bag into which the fish are received. The upper edge or back of the net is kept in a perpendicular position by cork floats, while the foot rope is weighted with leads.

The *ground seine,* "foot-seine," or "scringe-net" is employed where the sea-bottom is smooth, and an eligible place exists where it can be dragged on shore. Generally similar to the common seine, it has a pole fixed perpendicularly at the outer end of each wing, and to this a long drag-rope is attached by a short bridle. One rope being left on the beach, the net is taken in a boat and passed out round the space it is intended to encircle, and the second drag-rope being landed, the net is evenly hauled on shore by the fishermen.

Common seines or *stop-seines* are such as are lifted at once with the enclosed fishes into the boat, and should an inner or smaller boat not be employed for the purpose of removing the enclosed fish, it is termed a tuck-seine (vol. ii, page 227); while a modification of the seine is employed in the United States, and has been so off Cornwall, in which the materials used are

* For modes of sea-fishing see "The Sea Fisherman," by J. Wilcocks, and "Deep Sea Fishing," by E. Holdsworth.

SEINE-NET BEING LANDED ON SHORE.

light, and there are no leads along the foot-rope, but instead there is as an addition a draw-rope or purse-string along the whole length of the bottom of the seine, for closing the net below the fish, and, in place of leads, the small iron blocks through which the rope is rove answer the purpose of sinkers. When the seine surrounds the fish, the bottom rope is at once tightened, so as to prevent the fish from escaping downwards, which gives the seine the appearance of a purse. In Cornwall a centre weight is used to slip along the draw-string, which quickly and effectually closes it.

Peter-nets have floats along the upper rope and weights along the foot-line, one end is attached on shore, and the other anchored out at sea on a right line with the coast.

Drift-nets are mainly employed for the capture of gregarious fishes, or such as swim in shoals, as the mackerel, herring, pilchard, and in some places the sprat, while the Norwegians use them for taking cod. These drift-nets are the only way in which some forms that are found far from land can be netted. They may be likened to a wall of net suspended above any depth of water in the ocean, and permitted to drift with the tide in any direction, in the hope of meeting a shoal of fish. The size of the mesh must be in accordance with that of the fish which it is desired to capture, for the intention is to mesh the fish or permit them to push their heads and gill-

covers into the net, but being too small for the body to go through, while the gill-covers prevent their withdrawing themselves. These nets are generally set at night, and are as a rule more successful in dark weather. Drift-nets usually have no sinkers, but are worked on a single line, often many hundred yards long, supported along their upper edge by corks or floats, and sunk to the desired distance below the surface. A number connected together are termed a train, drift, or fleet of nets; the most important are those used for the herring (see vol. ii, page 221).

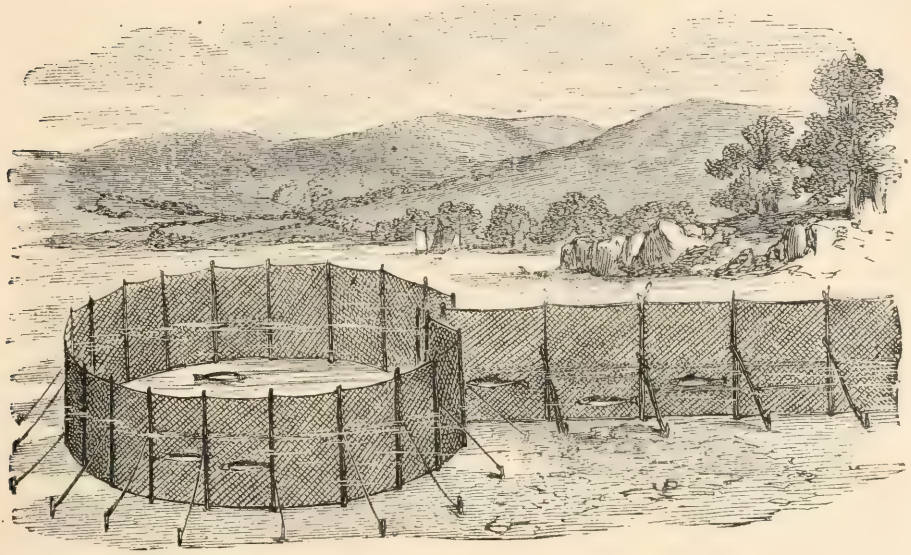
SHOOTING A HERRING NET.

Moored nets are employed in sheltered places for the capture of herrings (vol. ii, page 215), as along the coast of Devonshire and in some Scotch lochs. One form is termed a "bratt-net" and is used in the north for the capture of turbot, hake, skate, &c.

The *trammel* is a set or fixed net which is said to derive its name from the Latin "tres maculæ," or the French "*trois mailles*," "three meshes," evidently thus named with reference to the three descriptions of meshes of which it is composed (vol i, page 23). It is shot with the tide generally

of an evening, and to prevent its captures being injured by crabs or other vermin it should be examined every three or four hours (vol. i, page 23).

Weirs * *and fixed engines* were in 1861 declared by the Legislature to be a public nuisance, and abolished by law in England and Wales; but so many exemptions have been permitted, that it almost seems as if they were again being introduced along our sea-coasts, or rendered more destructive by the shortening of weekly close times at the mouths of some of our larger



KETTLE-NET.

rivers. But few things do more injury to fisheries, as they destroy fishes of all sizes, and in many places irrespective of their condition. If the interests of the fisheries and fish consumers alone were considered, not only every fixed engine should be utterly done away with, leaving the question of compensation to be settled by some competent court, but also semi-fixed engines as lave-nets, and likewise the immoderate use of seines should be jealously watched and regulated. Perhaps the most simple is the kettle-net for mackerel, used along the south coast, or the stop-nets and weirs of Swansea Bay; but they, and the various fixed engines employed in fresh waters, are so numerous and so diversified that space will not permit even their enumeration in this place.

* The old Saxon word "weir," says Seebohm ("English Village Life"), meant anything used for catching fish, whether fixed or movable. The word "putcher" indicated a weir made of puts.

† On the Thames the law enacted that no fish-weir was allowed to exist to the danger of the broods of young swans, but it might be dismantled at the discretion of their guardians.

*Line-fishing** in the sea, as employed for the capture of commercial fish, may be divided into two kinds, hand-lining and long-lining, while angling does not call for any remarks. It may be observed that fish are very insensible to pain (vol. i, p. 5).

DISEASES AND CAUSES OF DESTRUCTION.

The diseases and causes of the destruction of fish may be divided into (1), those due to the condition of the water in which they reside; (2), atmospheric disturbances and accidental causes; (3) diseases by which they are affected, including those of the ova and of infancy; (4) misplaced energy in fishermen and poachers; (5), injuries occasioned by the lower animals.

1. Waters may be virulently and directly poisonous, at once affecting the life of the contained fish and even that of cattle or man; or else they may be rendered mechanically unfit for fish to live in, as when the presence of mud chokes their gills and prevents respiration. Or the water may be indirectly affected owing to some deleterious agency having destroyed the living food which was previously present, or occasioned disease in the resident fish. When a river in India becomes unduly full of mud the crabs retire to the banks, and even the eels leave the stream for the wet grass in the vicinity. This attempt to escape from water loaded with ingredients inimical to life has likewise been observed among the invertebrate forms of Europe, as was some years since pointed out by M. Gerardin, in France. A series of experiments and investigations showed that colour, taste, odour, or chemical composition cannot invariably be accepted as criteria of whether water is wholesome or the reverse, but that such must be looked for in its effect upon the animals and plants which reside in it. When fish died from river pollution, it was observed that molluscs sometimes saved themselves by hiding under leaves and waiting there until the danger had passed away; thus, in July, 1869, Limnæa remained five days out of the water.

Among plants one of the most delicate was found to be the watercress, and it was remarked that when some deleterious substance from a starch factory obtained access to the Croult above the cress-beds of Gonesse, all these plants died within a few hours; the pollution removed, the cress-beds again flourished. Pond weeds and veronicas only live in water of good quality; mints, rushes, and water-lilies, accommodate themselves to mediocre water; *Carex* is still less sensitive; and lastly, the most robust of aquatic plants is a species of reed, the *Arundo phragmites*, which resists the most infected water. Among molluscs, the *Physa fontinalis* lives only in very pure water, the *Valvata piscinalis* in that which is healthy, while others

* The reader is referred, for a full account of the various modes and manners, to the "Sea Fisherman," by J. Wilcocks.

can reside in that which is of mediocre quality; no mollusc will live in what is thoroughly polluted. The phanerogamous plants thus sketch in distinct traits, the characters of different streams; but infusoria and cryptogams, and particularly algæ, may also enable one to judge in the matter by the modifications to which they are subject from alteration of the water. These lower organisms survive after the disappearance of fish, of molluscs, and of green herbs. As the alteration of the water progresses the river loses its limpidity, it becomes opaline, and this gray colour resists filtration. The surface is covered with froth, and the water deposits a dark, fetid slime, whence bubbles of gas are liberated. Presently there appear sulphurets, especially sulphuretted hydrogen, and the emanations of the river blacken silver and cooking utensils that may be exposed to them. M. Gerardin observed that when water contains the normal proportion of dissolved oxygen it may support the life of fish and herbs. As the oxygen diminishes the animals having active respiration disappear first, then those whose respiration is lower. And he gives as an example the black leech, which will exist in water wherein the shrimp at once dies.

Waters have been directly poisoned due to the refuse from a gas tank having obtained access to the river; by mine water, chloride of lime, caustic potash, the refuse from manufactories, paper mills, bleaching grounds, tanneries, or sewers; artificial root manure, sheep dipping; beer unfit for consumption having been emptied into fish ponds; the overflow of peat bogs, and other destructive agencies. The more rapid the current the more quickly are poisons entering the stream diluted, and the less chance of their being immediately destructive to the fish. Fish themselves appear to dread foul water, and some of our rivers which used to afford salmon, shad, &c., are no longer frequented by them. The wash occasioned by steam launches in a river may destroy or cast on the banks eggs or broods of young fish, as may likewise a very high tide. Water which is sufficiently pure for some species, as members of the carp family and notably the gudgeon, to reside in, may not be sufficiently so for those of the salmon family. Widespread destruction is occasionally observed in the sea owing to some cause inimical to the lives of fish, and this has been attributed to deleterious agencies from the shore, poisons carried down by rivers, the eruption of some noxious volcanic gases from the sea-bottom or sulphuretted hydrogen generated from animal or vegetable decomposition acting on the sulphates of soda and magnesia contained in the sea-water.

2. Atmospheric disturbances and accidental causes may also be destructive: thus a frost or low temperature has been known to affect the sand smelt, ballan wrasses, pilchards, conger, eels and other fishes; but it is remarkable how fish apparently frozen may occasionally be resuscitated. Electric disturbances may be a cause of the death of fishes. Thus during

1879 the occupants of a small fish-pond at Seck, in the Duchy of Nassau, were destroyed by a flash of lightning. The following morning the whole of the fish were discovered dead on the surface, having all the appearance of having been half-boiled, while they crumbled to pieces on being touched. No injury could be seen, but the water in the pond was still muddy and dull the morning after the storm. At 3 p.m. on July 7, 1865, a flash of lightning, observed Mr. Lloyd, struck a house in Hamburg, and about 200 feet away in a shady spot in the garden, and in the open air, was a large fresh-water aquarium containing forty-three fish, consisting of tench, carp, dace, roach, gold-fish, and eels, two species of loach, etc. At the moment of the flash of lightning every one of these fish became suspended perpendicularly downwards in the water, with their tails at the surface, feebly and vainly trying to swim towards the bottom of the tank, with all their fins strangely attenuated, as transparent as fine tissue-paper, and densely covered on both sides with myriads of fine air-bubbles; their heads and bodies were not so covered. In less than half-an-hour forty-one were dead, strongly curved, almost in the form of semi-circles, and already fast decomposing; but two gradually recovered by being placed in running water.

Hail and thunderstorms united will sometimes depopulate rivers in tropical countries (Dobrizhoffer). On July 3, 1866, several salmon in Scotland were killed by lightning during the intensely hot weather that prevailed. Gales, likewise, are occasionally destructive to fish. Thus, on April 13, 1874, one at Scilly was so violent that large fish, as conger, hake, ling, &c., were tossed about in their watery homes, and at last flung by hundreds on the rocks. Some had their scales knocked off, others their heads stove in, while even those which live at the rocky bottoms fared no better than their neighbours. It is well known that a high temperature is injurious to fishes: thus about June 10, 1882, a great destruction of trout occurred in Harry Loch, in Orkney. The weather reduced the water in the Loch, and the trout gathered in great shoals around the burn-mouths, where they were landed in hundred-weights by the neighbouring farmers, who are mostly small proprietors. One fisherman-farmer landed a thousand trout in one haul; while on another occasion five cartloads were caught in a single sweep.

Waterworks may suck in young fry by hundreds. The action of dynamite is very destructive, and when blowing up the ruins of the Tay bridge, fish as much as two miles away were destroyed: those killed sunk, those only stunned mostly floated.

3. Diseases by which they are directly affected, including those in the ova state and infancy, as developmental or monstrosities, malformations or consequent upon accidents. Space will not permit me to enter upon the

many affections from which fishes suffer, from the fungus of the young to the numerous diseases of a contagious or non-contagious character.

There are certain animal parasites which affect fish, and which may be briefly divided into such as are (*a*) internal or *entozoa*,* and (*b*) external or *epizoa*, irrespective of which are infusoria and parasitic fungi.

Entozoa are very common, and it has been computed that each fish may probably have, as an average, not less than four distinct species of guests able to occupy its body. Tapeworms would seem to be very numerous, but most of their entozoa appear to undergo transformation after changing their abode, the final host being often a water-bird.

Epizoa are seen as small crustaceans, many having the mouth modified into a suctorial tube or beak, within which are lancet-shaped mandibles employed for piercing. Of these epizoa we have two large subdivisions: first, such as are essentially surface forms, as fish lice, which can move from place to place by means of their hooked and prehensile antennæ, or even leave the fish and swim freely in the water; secondly, the more sedentary forms, as Lernea, having their heads frequently embedded in the bodies of their victims, and without powers of locomotion. Often the whole of their external organs are rudimentary, and they may be found in fishes' eyes, gills, mouth, vent, nostrils, and fins.

Infusoria are everywhere, in fresh or saline water, and some forms are endoparasitic in the alimentary canals of fishes, as well as other parts of their bodies.

Parasitic fungi may also occur: thus one of a highly contagious character has been of late years very destructive among fresh-water fishes. This fungus, *Saprolegnia ferax* (see vol. ii, page 81), has probably been always present, but requires a soil suitable for its germination and growth, and although some of the following may be the predisposing cause to the disease, still it has been observed where none such could have existed. The fish, particularly salmon, may be rendered susceptible from many causes, as debility, and especially after injuries occasioning abrasions, as male kelts after the breeding season, and also unspent kelts, but young fish may likewise be affected. Frosts, droughts, and polluted waters favour its development, and possibly were there fewer kelts preserved, and the waters of our rivers purer, we should find less of this disease, especially where the currents are rapid. Overfeeding appears to predispose to it in some pieces of water. The use of rock-salt is believed to be the best mode of treatment in our fish-ponds and aquaria, while migrating to the sea would seem to arrest the fungus, although it is not certain that it will not reappear on the fishes' return to the river.

* See Cobbold on the Entozoa: he most correctly observes that cooking fish infested with worms destroys their vitality, while these forms are not capable of existing in the human body.

4. The effects of misplaced energy in fishermen and poachers is a subject too vast to do more than allude to in this place, but the especial attention of legislators ought to be drawn to the fact that increased present productiveness may be carried on at the expense of future years' supply, and multiplying modes of destruction does not invariably tend to the benefit of the fisherman or of the consumer.

5. *Injuries occasioned by the lower animals* are numerous, and differ somewhat in the adult stage from what they do among the ova and young. Adult fish suffer greatly from porpoises and their allies, otters, birds and various species of their own kind; whilst the ova and fry may be destroyed by rats, birds (even robins), watersnakes, newts, frogs, leeches, and a variety of other agencies.

ARTIFICIAL CULTIVATION OF FISH.

The cultivation of fish has for its chief object an increase in the number or size, and likewise an improvement in the breed of those in fresh waters, or even of the sea, not only by direct cultivation of the finny tribes, but also of the food on which they subsist, and an eradication of what may be detrimental to their prosperity. This would include whatever assists them in their ascent or descent of rivers, when doing so to continue their kind or maintain the life of each individual (*see* figure of fish-pass, page lxxviii). When inland fisheries are impoverished the aid of legislation has generally to be invoked, in order to protect what is left, permit nature to play her part in their recovery, and, if necessary, to have desirable forms artificially propagated.

Our inland waters consist of such as streams or rivers, broads, canals, lakes, and ponds: while some rivers are rapid and clear, others are sluggish and more or less muddy. Different classes of fish inhabit these various localities; those most esteemed and generally looked upon as game-species are the Salmonidæ, while the coarse fish consist of perch, pike, and members of the carp family. As a general rule the first are found in running water and lakes, whereas the latter prefer more sluggish streams, broads, and ponds.

The artificial cultivation of salmon and trout has been found necessary in these islands, for reasons already stated (page lxx), and a great gain would have accrued were it not for the over-fishing which is now permitted in the lower reaches of the rivers (page ciii). The ova of the Salmonidæ can be obtained from fish captured in the waters they frequent, or their redds in the rivers and streams may be plundered, or the parents may be purposely kept in breeding-ponds.

The mode of spawning or stripping fish, as salmon or trout, requires practice, and the experienced fish-culturist will obtain a larger supply of eggs from a ripe fish than will an inexperienced or careless manipulator. Having obtained what appears to be a fish in a suitable condition, gentle pressure along the abdomen must be exercised, when ova from the female or milt from the male should be forthcoming; occasionally the former sex will require a little coaxing, as she will not always yield at the first attempt. If the eggs are not quite ready the distended abdomen feels hard and somewhat unyielding; whereas in ripe fish it is soft, and the ova can be felt moving under pressure of the hand. It may be necessary to detain these fish in suitable receptacles for a few days, either because the eggs or milt are not quite ripe, or else consequent upon only fishes of one sex having been taken.

The necessary apparatus for spawning fish consists of a shallow tin or earthenware pan, for receiving the eggs and milt, and which is furnished with a spout for the purpose of pouring them into the tin carrying-can, this latter having a perforated lid; also a jug for clean water, and a dry cloth is useful for assisting in holding the fish. The fish is held with its body somewhat sideways, and its tail directed downwards, while the pan to receive the eggs is placed below its vent, when by means of simple pressure, commencing from the ventral fins and passing downwards along the belly towards the vent, the eggs or milt are extruded.

There are two processes which may be adopted, the *moist* or water plan, and the *dry*. In the first some water is first placed in the pan which receives the eggs as pressed from the fish. In the dry process, on the contrary, the eggs are directly received into a dry pan, over them the milt is distributed, and the pan is gently agitated from side to side; after giving the eggs and milt time to mix, water is poured in to the depth of a few inches, stirred with the hand, and allowed to stand until they have hardened and freed (see page lxvi), a period of from one quarter to three quarters of an hour, according to the temperature, taking longest in cold water. The eggs must be properly cleansed by gently pouring clean water over them, and when this is no longer discoloured, the eggs may be transferred from the receiving to the carrying-can, which transference should not take place too soon. Any milt left on the eggs will cause injury in the hatching troughs, so should be thoroughly washed off. The most prolific milt seems to be of medium consistence. The eggs are now removed to the incubation house.* Irrespective of the foregoing, plans have been successfully adopted in some fish establishments in the United States to permit breeding-fish to

* For directions as to hatching and rearing young fish, the carriage of eggs and young, and the stocking of pieces of water, the reader is referred to the various existing works on fish-culture.

ascend the stream which feeds the pond, but having wire trays so fitted that the eggs when deposited drop through into a receptacle for their collection. Some observers, however, appear to think that, due to the rapidity of the current, the milt is often washed away before it has performed its function, and consequently a number of ova escape impregnation. Rough fish may likewise be artificially cultivated, as has been remarked upon (page lxvii).

In stocking pieces of water with eggs or young of Salmonidæ it would seem desirable that great attention should be paid to the age and condition of the parent fish, as I have observed (page lxix). I assume that care will be taken that the water is appropriate, for although new stock may tend to improve local breeds in suitable places, such will not be the case should the food be insufficient or inappropriate. Perhaps the Lochleven race of trout grows as fast as any other in these islands, especially when the eggs are from seven or eight year old parents, while in the warmer south they increase more rapidly in size than in the colder north.

The introduction of exotic forms of fish into our fresh waters has been advocated, a proceeding which, although it may be beneficial, on the other hand may be the reverse. It should first be considered whether the stranger subsists upon a vegetable or animal diet, and secondly whether sufficient exists for his consumption where it is proposed to acclimatize him. Anadromous forms may be beneficial, due to the small amount of food they generally require when ascending the rivers to breed. Carnivorous forms may be useful, in order to diminish too large a number of coarse fish in a river, where they are in excess of its capabilities for supplying them with sufficient nourishment; but when they have thinned down the primitive stock they may continue to deplete the fishery to too great an extent, and be a nuisance in their turn.

It is not surprising that the *cultivation of fish-ponds* for coarse fish has decreased or almost disappeared from this country, because increased facilities of carriage of fish from the sea-coast has rendered their produce of but little value; and as such has become less and less esteemed the care bestowed on ponds has been diminished until at last they may be said to produce fish of an earthy or muddy quality. If left unattended to they must deteriorate: they should not stand full more than two or three years unless the proprietor revels in the contemplation of miserable half-starved forms. The best treatment appears to be rotating crops of vegetables with crops of fish, for which purpose at least three ponds are requisite, although more are undoubtedly advantageous.

The aspect of the ponds, nature of the soil and character of the water are all factors to be taken into account, hard clays and gravel being generally unfavourable, and a marly soil mostly to be preferred. In constructing a

pond it should not be too deep, shallows being necessary for the fry which rarely go into deep water, which being colder in the summer than the shallows is less frequented by insects. Trees in their vicinity are detrimental because the leaves falling into the water occasion the formation of a black mud, and the escape of fœtid gases, which in winter, especially when the water is covered with ice, become very injurious to the fish. Rank vegetation along the banks is often injurious, although some weeds when present afford shelter and assist in clearing the water.

There should always be facilities for running a fish-pond dry, and the same depth of water should be maintained throughout the year. The inflow of water should never be direct from a brook but conducted from one side, and the sluices should be strong enough to render overflow impossible, while there should be a grating to keep out strange fish. The centre of the pond should be deeper than the rest, while near the outlet should be a spot still deeper than any other part of the pond.

The number and sorts of fish suitable for stocking ponds depends on many circumstances, especially as regards the food which is present, whether the water comes from a stream or from springs, and many other conditions. Boccius recommends the following as suitable for an acre of water: 200 brood carp, 20 brood tench, and 20 brood pike. North cautions the fish-culturist against over-stocking and recommends that after the first year they should be diminished because the food will decrease. When a pond is dried the contained fish should be examined as to whether they are in good or bad condition, from which it must be judged whether the water has been under- or over-stocked.

In 1754, Mr. Tull communicated a paper to the Royal Society respecting how he had castrated certain carps, and asserting that their flavour had become much improved consequent upon the operation.

Salt-water vivaria have been tried with varying success, and one would imagine that with care and attention they might be made suitable for the reception of some marine forms as bass, mullet, &c., so that a constant supply to the market would be available even at the periods when gales hinder the sea-fisherman's occupation. These vivaria may be placed on the coast and either be entirely supplied with salt-water by means of tidal influence, or may be lakes wherein the lower portion consists of salt or brackish water and the upper of fresh, where it may be fed by a stream. The locality selected, irrespective of all advantage of situation, should be where the necessary food could be obtained at a cheap rate, whether such is the refuse of fish, meat offal, shell-fish, or manufactured substances. Also, should the local demand for fish be insufficient there ought to be the means of inexpensive and easy carriage to a suitable market. Several such vivaria have been formed at different places around these islands at various times; Parnell mentions

one near Queensferry; Buckland one at Port Logan in Wigtonshire, &c. Mr. Bland of Derriquin Castle, Kenmare Bay, had in an inlet of Sneem harbour, protected by reefs of rocks, a strong barrier of stones formed across the entrance but through which every tide flowed and ebbed, but leaving a sufficiency of water within. Here mullet, whiting, sea bream, soles and plaice succeeded best, haddock also did well, but gurnards became pale in colour. Whiting became so tame as to feed out of the hand, and all assembled at the feeding-time on the appearance of the tray. While marine fishes have been acclimatized to fresh water (page lxxxiii, and vol. i, page 229, and vol. ii, page 123).

ARTIFICIAL HATCHING OF MARINE FISHES.

I have already remarked how depeopled fresh-water fisheries have been restocked by artificial means, and must now briefly record how in the United States this procedure has also been turned to practical account with salt-water fisheries. The Government Fishery Commissioners finding a difficulty in regulating the modes of capture in the sea, but observing that the fisheries were becoming impoverished from over-fishing, conceived the idea of propagating marine forms, as they considered that it would be useless to expect fishermen to stock public waters at their own expense, especially as everyone would subsequently be at liberty to catch the fish. Acting upon this principle the United States Fishery Department have wisely investigated their seas, repopulating their waters where the necessity exists, and thus counteracting the waste which is being occasioned wherever man has liberty or licence to capture the finny tribes however he pleases, irrespective of season and regardless of their condition.

FISHES OF GREAT BRITAIN AND IRELAND.

Class.—PISCES.

Vertebrate animals which, as a rule, are exclusively adapted for an aquatic life, and have their extremities modified into fins. Respiring, almost invariably, solely by means of gills:* possessing a heart with only two cavities, and being cold-blooded. They are scaleless, partially, or wholly scaled, the scales being sometimes in the form of osseous plates.

Sub-class I.—TELEOSTEI.

Skeleton osseous. Brain distinct. Skull possessing cranial bones. Vertebræ completely separated, and the posterior extremity of the vertebral column bony, or having bony plates. Branchiæ free, and the water discharged through a single aperture, protected by a bony gill-cover, or opercle: branchiostegal rays present. A non-contractile bulbus arteriosus, having a pair of valves at its commencement. Optic nerves decussating. Intestines without any spiral valve.

Order I.—ACANTHOPTERYGII.

A portion of the dorsal, anal, and ventral fins unarticulated, forming spines.† Air-bladder, when present, completely closed, not possessing a pneumatic duct.

Geographical distribution.—The spiny-rayed or Acanthopterygian order of fishes appear to be most numerous in the ocean, preying upon their weaker neighbours. Whereas, if we examine inland fresh waters, we observe the Malacopterygii as the *Salmonidæ* and *Cyprinidæ* usurping their place; these latter having solely articulated, but no spinous, rays.

First group—Perciformes.

Body elevated or oblong not elevated. No superbranchial organ. Spinous dorsal fin well developed: anal similar to soft dorsal; ventrals thoracic, usually 1/4 or 1/5. Vent remote from caudal fin and posterior to the ventral.

Family, I—PERCIDÆ.

Percoidei, pt., *Sciænoidei*, pt., et *Mænides*, pt., Cuv.; *Percidæ*, pt., *Theraponidæ*, pt., *Hæmulonidæ*, pt., Richardson; *Percidæ*, pt., et *Pristipomatidæ*, pt., Günther; *Ambassoidei*, pt., Bleeker.

Branchiostegals from five to seven: pseudobranchiæ present. Form of body generally oblong. Muciferous system of head rudimentary or but slightly developed. Eyes lateral. No superbranchial organ. Preopercle entire or serrated: cheeks not cuirassed. Mouth in front of snout, having a lateral cleft, occasionally on the lower side, moderately or rarely very protractile. Teeth in the jaws villiform, with or without canines, present or absent on the

* Certain fishes, mostly residents within or near the tropics, as the *Labyrinthici* and *Ophiocephalidæ*, even when a bandage is fastened round their gill-covers, entirely precluding their employment for respiratory purposes, are still able to live in water, provided they can obtain direct access to atmospheric air. In the majority of fishes such a proceeding would be rapidly fatal.

† There are some genera in which the fins can hardly be said to have any true spines, as among the *Trachinidæ*, *Aulostomatidæ*, *Ophiocephalidæ*, *&c.*

vomer and palatines. Anterior portion of the dorsal fin spinous: ventrals thoracic 1/5 or sometimes 1/4. Scales ctenoid or cycloid. Lateral line when present continuous (except in some species of Ambassis). Air-vessel usually present and more or less simple. Pyloric appendages in varying numbers.

Genus I.—Perca, *Artedi.*

Branchiostegals seven: pseudobranchiæ present. Body oblong and somewhat compressed. Preopercle serrated, with denticulations on its lower limb directed forwards. Opercle spinate. Teeth villiform in jaws, on vomer and palatine bones: tongue smooth. Two dorsal fins separated at their bases, the first with 13 *or* 14 *spines: the anal with* 2 *spines. Scales rather small, ctenoid, not extended on to the upper surface of the head. Pyloric appendages few.*

Cuvier selected the Perch as an appropriate type for the first Genus into which he subdivided the *Percoides.*

Geographical distribution.—Fresh waters of both the Arctic regions, rarely descending to salt water.

1. **Perca flaviatilis,** Plate I.

Περκη, Aristotle, Hist. Anim. lib. vi, c. 14; Ælian, xiv. c. 23, 26.

Perca, Pliny, xxxii, c. 9, 10; Ausonius, A.D. 400, v, 115; Jonston, De Pisc. 1649, lib. iii, tit. iii, c. i, p. 156, t. xxiv, f. 3. *Une Perche de riviere,* Belonius, 1553, p. 291. *Perca major,* Schonevelde, 1624, p. 55; Artedi, Genera Piscium, 1738, Gen. 39, Syn. 66, species, 74. *Perca fluviatilis major,* Aldrovandus, 1638, v, cap. 53, p. 622.

Perca fluviatilis, Rondeletius, 1554, ii, pp. 196, 197; Salviani, 1554, f. 244*b*, 226; Gesner, 1558, p. 698, f. 168*b*, and Edit. 1598, fol. 168 and 172, c. fig; Willughby, De Historia Piscium, 1686, iv, c. 14, p. 291, t. S, 13. f. 1; Ray, Synopsis Methodica Avium et Piscium, 1713, Pisc. p. 97, No. 23; Gronovius, Zoophyl. 1763, p. 91, No. 301 and Mus. i, No. 36; Linnæus, Syst. Naturæ, Ed. 12, 1766, p. 481; Rutty, Natural History of the County of Dublin, 1772, i, p. 368; Pennant, British Zoology (Edition 1), 1776, iii, p. 254, pl. xlviii, (Edition 2), 1812, iii, p. 345, pl. lix; O. F. Müller, Zoologiæ Danicæ Prodomus, 1776, p. 46; Linnæus, Systema Naturæ, Gmelin, 1788, p. 1306; Marsigli, iv, t. xxiii, f. 1; Bloch, Fische Deutschlands, 1782-84, t. lii; Bonnaterre, Encyclopædia Ichthyologia, 1788, p. 126, pl. liii, f. 204; Lacépède, Histoire des Poissons, 1798-1803, iv, p. 399; Donovan, Natural History of British Fishes, 1802-8, iii, pl. lii; Shaw, General Zoology, 1803, iv, p. 545, pl. lxxix; Turton, British Fauna, 1807, p. 100; Jurine, Poissons du Lac Leman, 1825, p. 1; Cuvier and Valenciennes, Histoire Naturelle des Poissons, 1828, ii, p. 20, t. i-viii; Flemming, History of British Animals, 1828, p. 213; Nilsson, Ichthyologiæ Scandinavicæ, 1832, p. 81; Bonaparte, Icones, Fauna Italica, 1832-41, iii, p. 79, f. 1; Fries och Ekström, Skandinaviens Fiskar, 1836, pl. i; Jenyns, Manual of British Vertebrate Animals, 1835, p. 330; Yarrell, British Fishes (Ed. 1), 1836, i, p. 1, c. fig. (Ed. 2), 1841, i, p. 1 (Ed. 3), ii, p. 112; Cuvier, Règne Animal, Poissons, pl. vi, f. 1; Templeton, Magazine of Natural History (Series 2), 1837, i, p. 409; Parnell, Fishes of the Frith of Forth, 1838, p. 8; Swainson, Natural History of Fish, 1839, ii, p. 198; Demidoff, Voyage dans la Russie Méridionale, 1840-42, iii, p. 355; White, Catalogue of British Fish, 1851, p. 9; Thompson, Natural History of Ireland, 1856, iv, p. 69; Günther, Catalogue of the Fishes in the British Museum, i, 1859, p. 58; Schlegel, De Dieren van Nederland, 1862, p. 32, pl. 3, f. 2; Blanchard, Les Poissons des eaux douces de la France, 1866, p. 130, fig. 8; Collett, Norges Fiske, 1875, p. 15; Steindachner, Ak. Wien, SB, lxxviii, Abth. i, 1878, p. 399; Houghton, British Fresh-water Fishes, 1879, p. 1, pl. i.

Perca vulgaris and *P. helvetica,* Gronovius, Catalogue of Fish by Gray, 1854, pp. 113, 114.

Perca Italica, Cuv. and Val. ii, p. 45 (*variety destitute of bands.*)

Perch, Couch, History of the Fishes of the British Islands, 1862, i, p. 185, pl. xxxiv.

*Synonymy of American examples.**

Bodianus flavescens, Mitchill, Phil. Trans. New York, i, p. 421.

Perca flavescens, Cuv. Règne Anim.; Cuv. and Val. ii, p. 46; Agassiz, Lake Superior, p. 291; Günther, Catal. i, p. 59.

Perca granulata and *P. serrato-granulata*, Cuv. and Val. ii, pp. 47, 48, pl. ix.

Perca acuta and *P. gracilis*, Cuv. and Val. ii, pp. 49, 50; Günther, Catal. i, p. 60.

B. vii, D. 14-15 | $\frac{1-2}{13-14}$, P. 14, V. 1/5, A. $\frac{2}{8-9}$, C. 18, L.l. 55-60, L. tr. 7-9/19; Cœc. Pyl. 3, Vert. 21/20-21.

Length of head $3\frac{3}{4}$ to 4, of caudal fin $5\frac{3}{4}$ to $6\frac{1}{2}$, height of body $3\frac{2}{3}$ to 4 in the total length. *Eye*—diameter $4\frac{1}{2}$ to $5\frac{1}{2}$ in the length of the head, according to the size of the specimen, 1 to $1\frac{1}{2}$ diameters from the end of the snout, and also apart. Interorbital space slightly convex. The maxilla reaches to beneath the middle of the eye. Opercle with a rather strong and flattened spine, the lower edge of which, also of sub- and inter-opercles and shoulder bones very finely serrated, sometimes the serrations on the opercle are more or less blunted. A few minute serrations sometimes present on the lower edge of preorbital. Preopercle serrated along its posterior border, most strongly so at the angle, while several denticulatious, pointing forward, exist along its lower edge. *Teeth*—villiform in the jaws, on the vomer and palatine bones, but absent from the tongue. *Fins*—dorsal spines rather strong, increasing in length to the third which slightly exceeds half that of the head, they decrease in height from the fifth to the last: second dorsal fin lower than the first. Pectoral two-fifths the length of the head, but not so long as the ventral. Second anal spine slightly longer than the first and rather above half the length of the rays. Caudal with rounded lobes. *Scales*—ctenoid, 15 or 16 rows between the lateral-line and base of the ventral fin: 75 rows descend from the back to the lateral-line. *Cœcal appendages*—three: they are rather wide and of moderate extent. The length of the intestinal tract equals that of the entire fish excluding the tail or caudal fin. *Air-bladder*—destitute of any bones connecting it with the internal ear: it is large, simple, having thin walls, while its superior half is closely adherent to the under surface of the ribs and bodies of the vertebræ; inferiorly it is covered by the peritoneum. *Colours*—bright olive-green along the back becoming lighter beneath, where it is often yellow or dark yellowish-white, occasionally tinged with pink. About 5 transverse black bands descend from the back down the sides, the first from just in front of and below the two first dorsal spines: the second from the fourth to the ninth: the third from the base of the last two and commencement of the soft dorsal: the fourth below the middle of the soft dorsal: the fifth below its end, while a sixth often exists at the base of the caudal fin. Sometimes these bands arise from two roots, or are Y-shaped. First dorsal fin gray, with two black spots, one anteriorly, the other over its last spines.

In the United States and Canada we find the *Bodianus flavescens*, Mitchill, likewise termed *Perca granulata* and *P. serrato-granulata*, C. V.: also a variety from Lake Ontario which is deficient in the spot on the dorsal fin, *P. acuta*, Richardson: and an elongated form from Canada termed *P. gracilis*, C. V. These fishes have been distinguished from *P. fluviatilis* for the following reasons:—locality: also, exclusive of colour, due to the head being slightly longer, the snout more pointed, the skull smoother, and the preopercular denticulations finer: the formula also being D. 13 | $\frac{2}{13}$, A. $\frac{2}{8}$. The *P. serrato-granulata*, C.V. is said to be thicker, skull and opercle more striated, the latter being denticulated along the lower border, while the number of denticulations along the lower edge of the preopercle are more numerous and finer than in the European species, D. 14 | $\frac{2}{13}$, A. $\frac{2}{7-8}$: also the scales are somewhat smoother. *P. granulata* has the vomerine teeth stronger than in the other forms, the denticulations on the preopercle very fine especially along its lower edge: the surface of the parietal covered with granulated and raised lines: opercle feebly striated and destitute of

* All the references to works treating on these fishes in foreign countries cannot be included, due to the amount of space such would require.

denticulations. Professor L. Agassiz having most kindly supplied me with examples from the Cambridge, Mass. Museum, from which Professor Garman has selected five of the form *P. flavescens* with very great discrimination; they afford the following results, D. 13-14, | $\frac{1-2}{13-15}$, A. $\frac{2}{6-7}$, L. l. 55, 60, 65, 70; L. tr. 6-8/15-18. Length of the head $3\frac{1}{4}$ to $3\frac{1}{2}$, height of body varies from 3 to 4 in the total excluding the caudal fin. The radiating striæ on the summit of the head are entirely absent in some but very distinct in others, and the same remark applies to those on the opercle. In one the opercular spine is blunted, while the lower edge of that bone is roughly crenulated: 1, 2, or 3, small spines are directed backwards in three of these five examples; in the last this edge is quite smooth. Along the lower limb of the preopercle are from 6 to 11 forwardly directed denticulations. Thus the radiating striæ on the head as well as the denticulations are so subject to variety in the American forms that no specific value can be attached to them. The height and strength of the dorsal spines and rays vary, the weakest being the most elongated: while, as a rule, the more elongated the form the more pointed is the snout. Colour again is evidently of no specific value, two of these five examples have no transverse bands: two have 8 bands, and one has 7, irrespective of which they are either wide or narrow, well defined, or else between them are numerous spots or blotches. The spot on the dorsal fin likewise varies, and may be entirely absent. The form of the snout is similar to that of *P. fluviatilis*, or else more pointed. Holbrook long since pointed out that *P. gracilis* was a variety of *P. flavescens*, while Steindachner in 1878 remarked upon its specific identity with the European perch.

Varieties.—As to *form*, Linnæus refers to a distorted perch having a hunched back, found at Fahlun, in Sweden, where it is termed "Rudaborre:" Pennant observes that similarly malformed ones exist in Llyn Rhaithlyn, in Merionethshire. Pennell has likewise recorded similar fish in Cheshire, and they have been taken in other localities. As to *colour*—Cuvier has described examples in which the dark transverse bands were absent: some have been observed almost white: and others of a slatey-gray having a silvery tint. These variations in colour are perhaps due to the soil in which the waters exist where these fish were bred, but may remain even if transported elsewhere. One example, 18 inches long, and weighing $4\frac{1}{2}$ lb., was captured in 1866 near Great Yarmouth, in Ormesby Broad, with the transverse bands scarcely distinguishable, and the succeeding year one of 2 lb. weight in Virginia Water, which was quite destitute of any bands.—(Zoologist).

The *name* of this fish is of Greek origin, signifying "dark colour," which probably refers to its bands, while this nomenclature has been introduced with but little change into almost every European country. It is the *perca* of the Romans, the *perch* of the British Isles, *perc*, Welsh: the old Anglican, *bears*, Dutch, *baars*, German, *barsch*, or the "banded fish," *bors* or *pertsh*. *La perche*, French. The word *perch* formerly was spelt *pearch*. This fish possesses certain local or provincial names, as *barse* in Westmoreland, or if young *hurling*: *base*, Cumberland: *trasling*, Cheshire; *crutchet*, Warwickshire. Likewise those of one season are termed *tranling*, of two seasons *egling*, if of three *stichling*.

It has been very truly observed that in referring to the local names of plants as given by old authors, one should not lose sight of the fact that strict exactitude will not always be found, so it is also in fishes, for as in this day some persons term all small fresh-water forms "minnows" or "gudgeons," and all minute marine ones "sprats;" so our ancestors were not more particular than many authors belonging to the present generation, and who are neither fishermen nor naturalists. Thus the same name became applied to quite different species of fish while the same fish might have twenty distinct designations. The Saxons have represented one of their gods standing on the back of a perch with naked feet, as an emblem of patience in adversity and constancy under trial.

Habits.—Perch as a rule are gregarious fresh-water forms, which inhabit lakes, ponds, and rivers, more especially frequenting deep holes or where there is a gentle current, preferring the sides to the more rapid parts of streams. Occasionally they descend to salt water, and when found in such localities or

where it is brackish, their flavour for the table has been considered improved. In Norfolk they have been observed to associate with one another according to size, the larger ones keeping in select societies by themselves, and the smaller ones in similar companies.* Sluggish during the cold months, they become more active in spring, when they frequent the more rapid parts of rivers and the shallower waters. Mr. Manley, in his work on fishing, observes that he has found January and February the best months for perch fishing. In confinement they become very bold, and are easily tamed. In one of the tanks at the Westminster Aquarium they might be seen lying on the leaves of the larger water plants, which are two or three feet below the surface. They are very tenacious of life if the weather is not very hot or thundery, and may be conveyed alive to long distances after removal from the water, especially if surrounded by wet moss. In some parts of the Continent, as Germany, these fish are taken alive to market, when, if unsold, they are returned to stock ponds to await another opportunity. They are injuriously affected by thunder, and also by frosts.

The strong spines of their dorsal fins render large ones very formidable as food for pike, still the young constitute a tempting bait. Anglers who employ them as such usually first remove their back fin: while aquatic birds appear to relish their flavour. When very hungry perch are said to make a meal of even the spined-loach, *Cobitis tænia*, but usually avoid such as food. Lacépède states that they eat young water rats, and have been known to devour small snakes.

Means of capture.—Being very fearless, the perch readily takes a bait, and even a moderately skilful angler, using worms, coming across an assemblage of small ones while feeding, is pretty sure of numerous captures, as they gorge the hook. In some localities they are taken with night-lines, spinning bait or even netted; while they have been known to take the fly. Anglers now find that due to constant fishing, perch in some localities are more wary than was formerly the case, and the use of fine tackle is necessary while any tendency to quickness in striking is to be avoided.

Baits.—Worms, shrimps, small crustacea, the larvæ of insects and live-bait, as young frogs, newts, and small fishes, whether gudgeon, roach, dace, chub, or minnow: even an artificial fly has been found successful. Isaac Walton observes "that should you rove for a perch with a minnow, then it is best to be alive, you sticking your hook through his back fin: or a minnow with the hook in the upper lip, and letting him swim up and down about mid-water, or a little lower, and you still keeping him to about that depth by a cork, which ought not to be a very little one: and the like way you are to fish for the pike with a small frog, your hook being fastened through the skin of his leg, towards the upper part of it: and lastly I will give you this advice—that you give the perch time enough when he bites, for there was scarce any angler that has given him too much." Jesse remarks that these fish may be attracted to a given locality by placing a number of live minnows in a glass bottle, from which their exit is prevented by a piece of perforated zinc. When the astonished perch are looking in vain at the tempting strangers, another minnow used as a bait is at once seized. Most anglers are aware that should you happen to hook one of these fish and it is not taken, your chances of obtaining more bites from members of that community become diminished: often they instantly cease from patronizing the bait, as if the one which had escaped capture had informed its fellows. But frequently instances bearing the other way have been recorded "in removing the hook from the jaws of a fish, one eye was accidentally displaced and remained adhering to it. Knowing the reparative capabilities of piscine organization, I returned the maimed perch, which was too small for the basket, to the lake, and being somewhat scant of minnows threw the line in again with the eye attached to it as a bait, there being no other of any description on the hook. The float disappeared almost instantly: and on landing the new comer, it turned out to be the fish I had the moment before thrown in, and which had actually been caught with his own eye."†

* Fisherman's Magazine, i, p. 107.

† Cholmondeley Pennell, Angler's Naturalist, p. 51.

Breeding.—In some ponds perch increase in numbers very rapidly: spawning commences about the third year of the fish's life, when they have attained about 6 inches in length. The breeding season is from March to the commencement of May, occurring even earlier in shallow water, while it is frequently continued until June. They have been known to breed in aquaria, and Bloch describes how they deposited their ova in long strings, in a glass vessel in which they were kept in his room. Near Paris the number of females to males has been given as 5 to 1, but such has not been generally recorded elsewhere. Mr. Manley however, in his "Notes on Fishing," states that 9 out of every 10 which an angler takes are females: in fact the proportion between the two sexes appears to vary in different localities. A fish of $1\frac{1}{2}$ lb. weight was found to contain 280,000 ova, but Lacépède, on the authority of Picot, gives nearly 1,000,000, however the size of the example is not stated. Buckland recorded 127,240 in one 2 lb. 11 oz. in weight, and 155,620 in one 3 lb. 2 oz. The size of the parent is one factor to be considered in computing the number of ova which seem to increase with the age of the fish: the weight of the eggs has been known to equal one-fourth of that of the entire fish. The eggs are about the size of poppy seeds, glued together by mucus, into stringy bands or mesh-work, having much resemblance to frog-spawn. The female selects a spot where rushes, reeds, or grass grow in the water, or else seeks a piece of wood or some hard substance, against which she rubs herself or presses, until one end of the glutinous band of ova has become attached: then gently swimming away the eggs become voided. These ova being readily observed are constantly being devoured by aquatic birds and other enemies. In the Thames swans destroy fish spawn to a great extent.

Their growth is slow, attaining to $2\frac{1}{4}$ inches in length at the end of the first year, and about 5 inches at 2 years of age: but the rapidity of their growth frequently depends upon local circumstances, especially as regards the purity or otherwise of the water, the abundance or the reverse of suitable food, and whether the locality is overstocked or not so. An example is recorded in which a perch having lived five years in an aquarium only attained 8 inches in length and then spawned.

Hermaphrodite examples have been recorded by Yarrell.*

Diseases.—These fishes are occasionally subject to epidemics. Thus in 1867 a perch plague destroyed hundreds of thousands in the Lake of Geneva, caused according to Dr. Forel and Dr. Du Plesis by the presence of certain minute fungi in the blood. It has been stated in Yorkshire that "after a certain age they become blind: a hard, thick, yellow fibre covers the whole surface of the eye, and renders the sight totally obscured. When this is the case, the fish generally are exceedingly black: and although from the more extreme toughness and consistency of the membrane, it is evident that some have been much longer in this state than others, yet there appears no difference either in their flavour or condition.† Yarrell suggested that this opacity may be the effect of local inflammation, produced by some of the numerous leech-like minute animals, which are found to frequently occur in the aqueous humours of the eyes of fishes.

Uses.—The Laplanders, according to Linnæus, employed the skin of this fish as a strong glue for the purpose of joining together the two pieces of different sorts of wood of which their bows were made. These skins were first dried, then soaked in a little cold water in order that the scales might be easily rubbed off: several of these skins were then enclosed in a bladder or piece of birch bark so that they might not become moist: they were then placed in a pot of water to boil, a stone being placed over the vessel in order to keep in the heat. Small perch are frequently employed as bait for pike and trout.

As food.—This fish, especially when from rivers, has been held in great esteem from the time of the Romans to the present day: in Ausonius's writings, when recording delicacies for the table, he observes that the perch must not be omitted, while among the fishes of the rivers, it is a worthy compeer to those of the sea, and may even compete with the sea-mullet. Ray remarks that owing to its

* British Fishes (Ed. 1), 1845, i, p. 91.
† Thomas Huxley, Fish of Maltham Water, Craven, Yorkshire.

excellent flavour it was termed *Perdix aquarum*. It has white flesh, which is firm in texture, delicate of taste, and easy of digestion. "In Ireland," says Thompson, "it is in little esteem as food." The Dutch are said to be partial to it when made into a dish termed "water souchey."

Those from various localities have had their praises recorded by different authors: in England they are reputed to attain their largest size and highest condition in Norfolk and Suffolk in the Yare and Waveney, where the water is slightly brackish; the improved flavour may be due to the presence of shrimps, which ascend so high in the autumn months. On the Continent those of the Moselle, the Danube, the Po, the Rhine, and the Swiss Lakes hold the highest place. Their flavour is considered best when they are in roe.

Perch may be boiled or grilled with or without the removal of their scales, while small ones are generally fried. On the Continent they are stewed in vinegar, or fresh grape- or orange-juice, or some sour sauce. Another plan is to spit them with their scales on, and baste with an acid juice while roasting; and Mr. Manley mentions that the best he has ever had served to him were skinned and broiled very delicately in buttered paper.

Habitat.—Generally throughout the fresh waters of Europe, also in the Siberian territories of Asiatic Russia. While in the Western Hemisphere it is found on the North American continent from the fresh waters which find their way into Hudson's Bay as far south as those which empty themselves into the Gulf of Mexico. In Scandinavia it is present, according to Nilsson, as far as the sixty-ninth parallel.

In Great Britain it is rare north of the Forth, unless it has been introduced within the present century, now it is present in the Deveron, in Banffshire (Edward), is common in the Forth and its tributaries, as well as in Scottish waters to the south of this river. It does not appear to exist in the Orkneys and Shetland Isles. It is almost universally distributed through England and Wales; but Borlase, in 1758, stated it to be unknown in Cornwall, where, however, Couch remarks that it has been introduced this century. It is absent from the Isle of Wight: while in Wales it is said to be chiefly confined to stagnant waters.

In Ireland it is pretty general though not universal. I have personally captured it near Longford, while the lakes of Mayo abound with it. Some naturalists believe it to be an introduced species, but Thompson observes that he is disposed to doubt this as it is so widely distributed. Kanahan, remarking upon the fishes of the River Dodder (1852), observes that there is good proof that it has existed there twenty years.

As to the *size* it attains, one of 3 lb. weight is considered a prize by the angler of the present day; Pennant mentions one of 9 lb. as having been captured in the Serpentine in Hyde Park, which a well known Norfolk angler (*Land and Water*, 1879) does not hesitate to express his disbelief in, observing that the largest he had personally captured was $5\frac{1}{4}$ lb., though he missed landing one that he estimated weighed half a pound more. Mr. G. Browne* records one from Bradgate Park, Leicestershire, which was found in a decomposed state on a night-line, it then weighed $5\frac{1}{4}$ lb., and in adddition to its putrid state, which doubtless reduced its weight, there was a large piece bitten out of its shoulder, most likely by eels: he concluded that when alive it would have been at least 6 lb. Montagu mentions one of 8 lb. from the Avon, in Wiltshire, captured on a night-line baited with a roach: and Hawkins, in the "Complete Angler," an example twenty-nine inches in length. Hunt one of 6 lb. from the Birmingham Canal: Donovan one of 5 lb. from the Bala Lake, while some of 4 lb. have been taken from Richmond Park and elsewhere. They appear to attain to their finest size in the largest pieces of water. The head, nearly 12 inches in length, of a perch, was stated by Bloch and others to have been preserved in the church of Luehlah, in Lapland, but which it has been surmised, with great probability, originally belonged to an example of *Sebastes Norwegicus*, known as a "sea-perch."

* Angler's Note Book, p. 29.

Genus II.—Labrax, *Cuvier.*

Dicentrarchus, Gill: *Roccus* and *Morone*, Mitchell.

Branchiostegals seven: pseudobranchiæ present. Body oblong or rather elongated. Preopercle serrated: opercle spinate. Teeth villiform in both jaws, on the vomer, palatine bones and the tongue. Two dorsal fins separated at their bases the first with 9 spines: the anal generally with 3 (occasionally with 1 or 2) spines. Scales ctenoid: of a small or moderate size. Pyloric appendages few.

Geographical distribution.—This marine and river genus of perches is found on the shores of the Arctic regions extending in Europe to the Mediterranean and Egypt: while it also exists along the coasts and rivers of North America. Professor Peters has likewise described one species, *Labrax Schœnleinii*, from the Celebes, proving that it may be present in the vicinity of the tropics.

The two European forms are distinguished by the teething on the vomer: which in the *Labrax lupus* form a simple, almost crescentic, band: while the spotted species, *L. punctatus*, has them in a triangular spot anteriorly, extending backwards in a straight line like the shaft of an arrow.

Gill and others have subdivided this genus more especially in accordance with the lingual dentition, the character of the serrations along the lower margin of the preopercle and the spines on the opercle. The number of anal spines has been observed to be inconstant.

1. Labrax lupus, Plate II.

Λαβραξ, Aristot. iv, c. 8, v, c. 9, 10.

Lupus, Plin. ix, cap. 17, 54, xxxii, cap. 2; Belonius, de Aquatilibus, 1553, i, p. 113; Rondel. Pisc. Mar. ix, c. 7, p. 268, c. fig; Salv. Aqu. 1554, xxviii, p. 108, f. 30; Gesner, iv, p. 506; Aldrov. Pisc. iv, cap. 2, p. 490, c. fig; Jonston, 1649, lib. ii, cap. 2, p. 103, t. xxiii, f. 3; Willughby, iv, cap. 1, p. 271, t. R. 1; Ray, Pisc. p. 83 and 132; Rutty, N. H. Co. Dublin, i, p. 367. *Perca*, Artedi, Gen. Pisc. No. 7, p. 41; Borlase, Natural History of Cornwall, 1755, p. 270, pl. xxvi, f. 19; *Basse*, Pennant, Brit. Zool. (Ed. 1) iii, p. 257, pl. xlix (Ed. 2) iii, p. 348, pl. lx.

Perca labrax, Linn. Syst. Nat. i, p. 482; Gronov. Zooph. No. 300, p. 91; Bloch Schn. p. 84; Bonnaterre, Ency. p. 127; Donovan, Brit. Fish. ii, pl. xliii; Turton, Brit. Fauna, p. 100; Risso, Ich. Nice, p. 299 and Hist. Nat. iii, p. 406; Flemming, Brit. An. p. 213; Schagerström, R. Vet. Acad. Hand. 1829, St, i, p. 90, t. 3, f. 5-7; Nilss. Scand. p. 82; Johnston, Fishes of Berwickshire, Mag. Nat. History, 1833, Vol. vi, p. 15; Martens, Reise nach Venedig, ii, p. 428; Jenyns, Brit. Vert. p. 331; Gronov. ed. Gray, p. 115.

Sciæna labrax and *S. diacantha*, Bloch. iii, t. 301, 302; Shaw, Zool. iv, pp. 534, 535.

Centropomus lupus, Lacépède, iv, p. 267.

Perca diacantha, Lacépède, iv, p. 418; Bl. Schn. p. 85.

Perca elongata and *P. sinuosa*, Geoff. Desc. Egypte, Poiss. pl. xix, f. 1 and xx, f. 3.

Labrax lupus, Cuv. Règne Anim. pl. vii, f. 1; Cuv. and Val. ii, p. 56, pl. xi; Yarrell, Brit. Fish. (Ed. 1) i, p. 6, c. fig. (Ed. 2) i, p. 8 (Ed. 3) ii, p. 118; Bonaparte, Faun. Ital. p. 79, c. fig; Val. in Webb and Berthelot's Ichthyologie des Iles Canaries, 1836, p. 5; Parnell, Fishes of the Frith of Forth, 1838, p. 170; Guichenot, Poissons dans l'Exploration Scientifique de l'Algeria, 1850, p. 31; White, Catal. Brit. Fish. p. 10; Günther, Catal. i, p. 64 (part) and Annals and Magazine Nat. Hist. (3) 1863, xii, p. 175; Thompson, Nat. Hist. Ireland, iv, p. 69; Steindachner, Ich. Spain and Port. Akad. Wien, 1867, p. 4; Collett, Norges Fiske, p. 15.

Bass, Couch, Fish. Brit. Isles, i, p. 189, pl. xl.

B. vii, D. 8-9 | $\frac{1}{12\text{-}13}$, P. 16, V. 1/5, A. $\frac{3}{10\text{-}11}$, C. 17, L. l. 72, L. tr. 10/20, Cœc. pyl. 5, Vert. 12/13.

Length of head $3\frac{3}{4}$ to 4, of caudal fin $5\frac{3}{4}$, height of body $4\frac{1}{4}$ to $4\frac{2}{3}$ in the total length. *Eye*—diameter $4\frac{1}{2}$ to 5 (or even proportionately larger in very small

examples), in the length of the head, $1\frac{1}{4}$ to $1\frac{1}{2}$ diameters from the end of the snout, and $1\frac{1}{4}$ apart. Posterior edge of the preopercle strongly serrated, the largest tooth being at its rounded angle, and three more forwardly-directed along its lower limb. Two opercular spines, the rest of the bones of the head unarmed. Jaws of about the same length anteriorly: the maxilla reaches to beneath the first third or middle of the orbit. Nostrils patent. *Teeth*—villiform in the jaws, the outer row in the upper somewhat larger than the rest: in an almost crescentic spot on the vomer, in a band on the palatines, and also at the base of the tongue. *Fins*—occasionally the first spine in the anterior dorsal fin is absent, the first two are short, the third 2/3 the length of the fourth, which is equal to the two succeeding which are the highest, and slightly exceed the length of the rays of the second dorsal. Third anal spine slightly longer than the second. Caudal forked. *Scales*—ctenoid. *Lateral-line*—nearly straight, passing from the upper edge of the opercle to the centre of the base of the caudal fin. *Intestines*—5 short cœcal appendages. *Colours*—gray on the back, becoming silvery on the sides and beneath. A dark spot at the upper half or two-thirds of the opercle, darkest posteriorly. Dorsal, anal, and caudal fins stained with gray externally: pectorals and ventrals yellowish-white. The young have usually some fine dark spots scattered over the body.

Names.—This fish, the *Labrax* or "sea wolf" of the Greeks, and the *Lupus* or "wolf" of the Romans, probably received its names due to its voracity and likewise to its cunning when hunting in shoals.

It is the Anglo-Saxon *bœrs*, now commonly known as *bass* or *basse*, which in old works may be spelt *bace: sea-dace* of Kent: *white salmon* of Herne Bay. *Draenog* and *gannog*, Welsh. *Gapemouth*, Scotland. *White-mullet* and *king of the mullets*, Belfast. *Le bars*, or *loup*, French. *Zeekarpel*, or *Zee-bars*, Dutch.

Habits.—A strong, active, and voracious fish, generally living in shoals; and although essentially marine, occasionally ascending rivers above tidal influence. They mostly arrive from the deep sea about May, returning there in October or November, and are very rarely seen throughout the winter months. They consume almost every form of animal substance, preferring such when living, they prey principally on small fishes and crustacea, and have also been recorded as eating sea-weeds. Couch states that they are very partial to *Onisci*, after which they venture among rocks during tempests, when their prey become washed out of their abodes: and it is during such stormy weather that they hunt along the shore, even in shallow water, although at other times they take their station under some sheltering rock, from which they dart out on passing prey. On August 10th, 1878, Lord Ducie, when yachting off the south-west coast of Ireland, observed that "the bass were hunting the sprats to the surface, the gulls assisting. This went on all day along the strand up to the embouchure of the Jung River." Bass prefer the vicinity of wooden piers to those constructed of stone, evidently due to the greater abundance of food at the former to what obtains in the latter locality. In Portsmouth Harbour, observes Mr. Barron, in its various branches, large ones are frequently obtained, while numbers of the young frequent Haslar Lake, where they appeared to feed on the *Actiniæ* which abound.

The Romans, aware of their habits, kept them in fresh-water aquaria, where they are asserted to have bred: the same experiment has been tried by Mr. Arnold, in Guernsey, with success, and their flavour was asserted by Dr. M'Culloch to be much improved by the change.

Means of capture.—The trawl: by deep sea lines or hand lining, also with small seine nets. In Belfast Bay they are said to be most frequently captured along with salmon, sea-trout, and mullets. At Mevagissey, in Cornwall, Mr. Dunn informed me that they found it impossible to net them unless the seines could be dragged on to a sandy beach: this however cannot be accomplished, owing to the nature of the ground, so they must be hauled into boats: stones are therefore thrown into the water, or other means employed to frighten the encircled fish, so that they do not take the opportunity to escape under the foot-rope. But bass are not to be thus alarmed, and as soon as the foot-rope is raised, so surely do

they swim away. These fish have even been credited with forming a depression in the sand by the use of their tails where they esconce themselves while the net passes over them. They take a bait freely at times, although occasionally nothing will tempt them: while they are very dexterous in getting off fish-hooks, and often manage to divide the lines. Anglers employ a long and strong rod, and, with suitable lines, try their luck from pier heads and projecting rocks, while the flood tide is much more likely to prove successful than the ebb: and the water must not be so clear that the bottom is discernible. Gorlestone Pier and the Britannia Pier at Yarmouth have been noted as suitable localities for angling for these fishes.

Baits.—The lug-worm or trolling with a sand-eel: while an artificial india-rubber bait has been found very killing. Also a soft crab, slip of a cuttle-fish or slice from a mackerel's tail. Neill found the fry of the sand-launce, and two young father-lashers in the stomach of one, Thompson detected young whiting.

Breeding.—Summer months, generally depositing their spawn near the mouths of rivers. About the end of March a 12 lb. fish in the Belfast market contained a vast mass of ova, smaller than the smallest clover seed (Thompson). Couch considered July and August to be the most frequent months for breeding in Cornwall, while on the Continent this fish has been said to deposit its ova twice in the year. The young frequent harbours and the sandy mouths of large rivers, but adults often lead a more solitary existence.

As food.—Its flesh is white and good for the table when the fish is from 12 to 18 inches in length. and quite fresh, but on being kept even to a second day it is said to often become oily and have a strong taste. However it is largely disposed of in Cheltenham as a second-rate fish, while it has usually been two days or more from the sea. The Romans considered this as among their prime forms for the table, holding those from the Tiber as superior to all others, while the small-sized spotted ones were preferred: the very best being captured between the two bridges of the city, a locality into which the main drains discharged their contents. The Greeks likewise esteemed this fish as highly as did the Romans.

Habitat.—A native of temperate Europe, extending from Norway and the British coasts to the Mediterranean: "it is very abundant," observes Steindachner, "along the north and west shores of the Iberian peninsula, especially where rivers debouch into the sea, but is rare on the eastern side of Spain."

In Britain it is most common in the summer months, along the southern coast, while towards the north it decreases in numbers. In Scotland it is rare to the north of the Frith of Forth: Edward records a single example found dead in the River Deveron, in Banffshire, in 1839: while it has not been recorded from the Orkneys and Shetland Isles.

In Ireland it was first noticed by Dr. Brown; it is well known but not numerous along its southern shores, but decreases in numbers towards the north, where it becomes rare: an example has been recorded from Portrush, in the county of Antrim.

A 10 lb. fish is considered a fine example, but Pennant records one of 15 lb. One 22 lb. has been netted close to Herne Bay Pier, and Yarrell alludes to one of 28 lb.

Genus III.—Acerina, *Cuvier.*

Gymnocephalus, Bl. Schn.: *Cernua*, Flemming.

Branchiostegals seven: pseudobranchiæ present. Opercle and preopercle spinate. Distinct muciferous channels on the head. Teeth in jaws villiform: absent from the palatine bones and tongue. A single dorsal fin with many spines (13 *to* 19): *anal with two. Scales ctenoid, and of moderate size, none on the head. Pyloric appendages few. Air-bladder simple.*

Geographical distribution.—The fishes of this genus are found in the rivers of the Palæarctic region, extending from Siberia and Russia as far south as Northern Italy. It has been remarked that their distribution is limited to rivers or waters which have their outlet in the Arctic Ocean or into European seas, similarly to the distribution of *Perca fluviatilis*. Irrespective of the *Acerina cernua* there are two other European species, the long-snouted *A. Schrœtzer*, with distinctly longitudinal bands, and a variety, *A. rossica*, in which these bands are indistinct or even absent, this fish is found in rivers flowing to the Black Sea: also the *A. czekanowskii* from the River Angera.

1. Acerina vulgaris, Plate III.

Cernua fluviatilis, Belon. Aqu. p. 291; Gesner, pp. 191, 192, 226; Willughby, p. 334 t. X 14, f. 2; Ray, p. 144. *Perca fluviatilis minor*, Gesner, pp. 29, 701, 825 f. 160 *a* and 161; Schonev. p. 56; Aldrov. v, c. 34; Jonston, De Pisc. lib. iii. t. 3, c. 2, t. xxviii; Ray, p. 144. *Perca*, Artedi, No. 3, Spec. p. 80 and No. 4, Genera, p. 40; Klein, Hist. Pisc. No. 1, v, p. 40; Duhamel, Pêches iv, p. 39, t. viii, f. 1; Marsigli, iv, p. 67, t. xxiii, f. 2. *Ruffe*, Pennant, Brit. Zool. (Ed. 1) iii, p. 259, (Ed. 2) iii, p. 350.

Perca cernua, Linn. Sys. i, p. 487; Gronov. Zooph. p. 86, No. 288; Schœffer, Pisc. Bavar. Ratis. Pentas; Bloch, t. liii, f. 2; Gmel. Linn. p. 1320; Donovan, Brit. Fish. ii, pl. xxxix; Shaw, Zool. iv, p. 548, pl. 79; Turton, Brit. Fauna, p. 100; Jenyns, Man. Brit. Zool. p. 334; Müller, Zool. Dan. Prod. p. 392; Gronov. ed. Gray. p. 112.

Gymnocephalus cernua, Bl. Schn. p. 345; White, Catal. Brit. Fish, p. 12.

Perca acerina, Bonnaterre, Ency. Ich. p. 134, pl. liii, f. 205.

Holocentrus post, Lacép. iv, p. 357.

Cernua fluviatilis, Flemm. Brit. An. p. 212.

Acerina vulgaris, Cuv. and Val. iii, p. 4, pl. xli, vii, p. 448; Fries och Ekström, Skand. Fish. p. 9, t. i, f. 2; Yarrell, Brit. Fish. (Ed. 1) i, p. 18 c. fig. (Ed. 2) i, p. 17, (Ed. 3) ii, p. 122; Cuv. Règ. Anim. Ill. Poiss, pl. ix. f. 2.; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 368; Gunther Catal. i, p. 72; Houghton, Brit. F. W. Fishes, p. 5, c. fig.

Acerina cernua, Günther, Wiegm. Archiv. 1855, p. 199, pl. x, f. 1, 2; Collett, Norges Fiske, p. 16.

Ruff, Couch, Fishes of the British Isles, i, p. 193, pl. xli.

B. vii, D $\frac{14}{11-13}$, P. 13-14, V. 1/5, A. $\frac{2}{5-6}$, C. 18, L. l. 40, L. t. 6/14. Cœc. pyl. 3, Vert. 15/20-22.

Length of head $3\frac{1}{2}$ to $3\frac{3}{4}$, of caudal fin $5\frac{1}{4}$ to $6\frac{1}{4}$, height of body $3\frac{1}{4}$ to $3\frac{2}{3}$ in the total length. *Eye*—diameter $3\frac{1}{2}$ to 4 in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and $\frac{3}{4}$ of a diameter apart. Body compressed, a concavity on the dorsal profile above the eye and occiput causing the snout to appear swollen. Upper jaw slightly the longer: the posterior extremity of the maxilla reaches to beneath the front edge of the eye. Opercle with a well

developed spine: the posterior edge of the preopercle with 3 or 4 sharp teeth, the lowest which is at the angle and turned downwards and forwards, occasionally the superior ones are double: lower edge of opercle with two forwardly directed spines. Lower edge of preorbital festooned. The openings of large pores, situated in depressions, extend in 2 rows along either side of the head, the superior being below the lower edge of the sub-orbital ring, and the inferior passing along the lower jaw and round the opercular margin. Anterior nostril the smaller and provided with a valve, the posterior oval and patent. Shoulder scale and one at angle of pectoral fin spinate. *Teeth*—in numerous villiform rows in jaws, none on vomer, palatines, or tongue. *Fins*—dorsal spines rather strong, the third and fourth the highest and equalling the length of the head behind the middle or even front edge of the eye, they decrease perceptibly in length from the 7th or 8th, while the last is slightly higher than the preceding one: rays lower than the spines. Pectoral as long as the head excluding the snout. Ventral does not reach the anal. First anal spine equals half the length of the head, and is usually slightly longer and stronger than the second, caudal emarginate. *Scales*—ctenoid, none on the head or fins: about 15 rows between the lateral-line and base of the ventral fin: 62 to 64 rows passing from the back to the lateral-line. Tubes along the lateral-line double. Intestines with a fold: its length from the pylorus to the vent equals that of the entire fish excluding the caudal fin. *Colours*—grayish, or olive-brown, spotted with black or brown, becoming lighter on the sides and almost white on the abdomen. Dorsal, caudal, pectoral, and anal fins with spots which may coalesce on the pectoral fins so as to form bands. Ventral, reddish-yellow.

Varieties.—Examples of a rather elongated form obtained from Russia exist in the Leyden Museum.

Names.—*Ruffe*, *ruff*, or *Jack-ruffe* are terms probably derived from the roughness of the edges of the scales: *pope* is said to be a term of contempt, a contemptuous phrase still in use in Dorsetshire being "what a pope of a thing." A cruel custom obtains near Windsor on the Thames, of pressing a cork tightly down on to the spines of the dorsal fin, and subsequently the fish is returned to the river. This is termed "plugging a pope," the origin of which is unknown. *Tommy-bars* is likewise a provincial term for this fish. *Y garwberc*, Welsh. *Pos*, Dutch. *La gremille commune*, French.

Habits.—A gregarious fresh-water fish, living in large companies, and keeping to the tolerably deep water, where it prefers cold and shady places to warm situations: thriving best in ponds through which a stream flows, canals, and sometimes selecting those portions that are rocky or strewed with stones and sand. It is lively in its movements and feeds on food similar to that which has been ascribed to the common perch. In confinement it becomes rapidly tame. Mr. Arderon (Phil. Trans. Royal Soc. 1747) tells us how he kept two in an aquarium where they became much attached to one another. He gave one away, when the other became so miserable that it declined all food, and this continued for nearly three weeks. Fearing his remaining fish might die, he sent for its former companion, and on the two meeting they again became quite contented.

Means of capture.—Similar to such as are employed for the perch. They are often taken by young anglers fishing for gudgeons and sticklebacks.

Baits.—Identical with those used for the perch or gudgeons, especially a red worm, while it is an equally fearless biter and a bottom feeder.

Breeding.—In the months of March or April its straw-coloured ova are deposited among the roots and stems of flags and rushes at the sides of streams. In the example figured, which weighed $4\frac{3}{4}$ oz. I found 205,000 well-developed ova, while more were present in a less advanced stage.

Uses.—This fish is frequently employed as a bait when trolling for pike or trout.

As food.—Its flesh is esteemed, especially during the spring and autumn, but is scarcely equal to that of the perch.

Habitat.—Fresh waters of Siberia and Russia, while it is common in the northern and central parts of Scandinavia, but rare in the southern districts. It

is found in Switzerland, Germany, France, and England, but said to be absent from Spain, Portugal, Italy and Greece.

In the British Isles it is common in the Severn, Cam, Thames, and the rivers and canals of the midland counties of England, especially where the bottom is of fine sand or gravel. It is not found in Devonshire, Cornwall, or the Isle of Wight. It is generally considered to be absent from Scotland, but Edward in 1877 observed "one is said to have been obtained off Troup Head, about forty-two years ago." It is absent from Ireland.

This fish was first noticed by Belonius who named and figured it: next Dr. John Caius took it in the River Yare near Norwich and sent a drawing to Gesner, termed *Aspredo*, "rough," which was published.

It rarely exceeds 7 inches in length. I am indebted for the example figured, natural size, to Professor Smidt of Archangel.

Genus IV.—Serranus, *Cuvier.*

Epinephelus, sp. Bloch: *Cephalopholis*, sp. Bl. Schn.: *Paraserranus* and *Serranichthys*, Bleeker: *Labroperca*, *Mycteroperca*, *Bodianus*, *Enneacentrus*, *Petrometopon*, *Promicrops*, *Schistorus*, and *Menephorus*, Gill: *Prospinus*, Poey: *Priacanthichthys* (*young*), Day: *Paralabrax*, *Paranthias*, and *Itaiara*, Vaillant and Bocourt.

Branchiostegals seven: pseudobranchiæ present. Eyes lateral, of moderate size. Preopercle with its vertical limb more or less serrated, its horizontal one generally entire: opercle with two or three flat spines. Teeth villiform in the jaws, vomer and palate: canines usually present: tongue smooth. Dorsal fin single, having from 8 *to* 12 *spines: anal with* 3: *caudal cut square or obliquely, emarginate or rounded. Scales small, ctenoid or cycloid. Pyloric appendages many, in moderate numbers, or few.*

These fishes, as might be expected in a genus which is so widely distributed, show many individual differences. The colour varies extensively and cannot even be accepted as a trustworthy guide for dividing *Serrani* into groups. The form of the preopercle is not invariably identical in every specimen of a species, or even on the opposite sides of the head in the same fish: while a spine is occasionally present at its angle in the immature, becoming more or less absorbed in the adult. The sub- and inter-opercles may be serrated or smooth in the same species, as is well exemplified in the Indian *Serranus bænack*. The fins also alter with age, owing to the spines not increasing in length so rapidly as the rays, consequently they may be comparatively shorter in the adult than in the young. Even the soft rays in the mature fish are of less proportionate height to the entire length of the specimen than they are in the immature. The same thing occurs in respect to the anal spines, the second being sometimes the longest in the immature, but shorter than the third in the mature: this appears usually due to the second spine augmenting in thickness while the third is increasing in length. Occasionally there is an excess of one spine and a deficiency of one soft ray in the dorsal fin, the first of the latter having taken on a spinous character, a phase which is seen more commonly in some of the *Sparidæ*. The number of the rows of scales is very important among these fishes, as so ably pointed out by the late Dr. Bleeker, who invariably counted the number of transverse rows going to the lateral-line from above and below. Hybrids have been recorded.

Geographical distribution.—Seas of temperate and tropical regions, sometimes ascending rivers for predaceous purposes. In the British Isles two species have been recorded, one a resident, the other an occasional or accidental visitor.

1. Serranus cabrilla, Plate IV.

Χανη, Salviani.

Perca, Rondel. vi, c. 8, p. 182, c. fig.; Gesner, Ed. 1598, f. 16, c. fig. *Perca marina*, var. B. Brunnich; Jonston, De Pisc. lib. i, t. ii, c. i, art. viii, p. 47, t. xiv, f. 10, 11, 12; Ray, p. 140.

Perca cabrilla, Linn. Syst. Nat. i, p. 488; Gmel. Linn. p. 1322; Jenyns, Man. Brit. Vert. p. 352.

Holocentrus virescens, Bloch, t. ccxxxiii; Bl. Schn. p. 313; Lacép. iv, p. 357.

„ *marinus*, Lacép. iv, p. 376.

Lutjanus serranus, Lacép. iv, p. 205.

Serranus marinus, and *flavus*, Risso. Ich. Nice, pp. 291, 293.

„ *cabrilla*, Cuv. and Val. ii, p. 223, pl. xxix; Yarrell, Brit. Fish. (Ed. 1) i, p. 9, c. fig. (Ed. 2) i, p. 11 (Ed. 3), ii, p. 129; Swainson, Fishes ii, p. 201; White, Catal. Brit. Fish. p. 11; Nordman, in Demid. Voy. Russ. Mérid. iii, p. 367; Guichen. Expl. Sc. Alger. Poiss. p. 33, pl. 1; Günther, Catal. i, p. 106; Steind. Ich. Spanien u. Port. 1867, p. 9.

Perca channus, Couch, Loud. Mag. Nat. Hist. v, p. 19, f. 6.

Serranus novemcinctus, Kner, Novara Fishes, p. 17, t. ii, f. 1.

Comber, Couch, Fish. Brit. Isles, i, p. 195, pl. xlii.

B. vii, D. $\frac{10}{14}$, P. 15, V. 1/5, A. $\frac{3}{7-8}$, C. 15, L. l. 80-90, L. tr. 9/25.

Length of head 3 to $3\frac{1}{4}$, of caudal fin 6 to 7, height of body $3\frac{1}{3}$ in the total length. *Eye*—diameter $4\frac{1}{2}$ in the length of the head, $1\frac{1}{3}$ diameters from the end of the snout, and 1 diameter apart. Posterior border of the preopercle serrated, most coarsely so at its rounded angle. Nostrils patent, the posterior the larger. Lower jaw the longer: the posterior extremity of the maxilla reaches to beneath the hind edge of the eye. *Teeth*—of moderate size, the outer row enlarged: villiform ones present on vomer and palatines. *Fins*—dorsal spines lower than the rays, increasing in length to the fifth, which equals $2\frac{1}{3}$ in the height of the body below it. Pectoral as long as the head excluding the snout. Caudal slightly emarginate. *Scales*—ctenoid, 10 rows between the lateral-line and the commencement of the soft dorsal fin. *Colours*—orange-yellow, lightest about the head, 4 or 5 stone-gray longitudinal narrow bands commence below the eye, two of which become lost on the head; while three going backwards become of a gray-blue colour, the middle one passing above the pectoral fin, reaches the middle of the side of the base of the tail, to which the two others likewise extend. Fins yellowish, the dorsal with numerous blue spots, which however become smaller posteriorly, and have a narrow black edge: similar spots on the caudal fin: while there are some larger but less distinct ones on the anal. Frequently transverse bands descend from the back; these may be unnaturally dark, which would give the appearance figured in *Serranus novemcinctus*, Kner. Some confusion has occurred respecting this species, due to Linnæus having described the *Sebastes Norwegicus*, under the head of this fish: while Bonnaterre, pl. 54, f. 210, reproduced Pennant's figure of the Bergylt as that of *Perca marina*, p. 128, probably a slip of the pen, it being evidently intended for the succeeding *Perca Norvegica*, the very reference to this figure under *Perca marina* being to pl. 56 whereas it is on pl. 54.

Names and their origin.—It is sometimes termed "*The gaper*," because when in its death agony it erects its fins and opens its mouth, and thus stiffens, as is commonly seen in many of the spiny-rayed or acanthopterygian fishes. *Bulls*, Mevagissey in Cornwall. *Smooth serranus.*

Habits.—Mr. Dunn observed in Cornwall that this fish is "plentiful in deep rocky gullies, and the very rough ground off our coast. It is most common in summer. Its food appears to be small fishes and crustaceous Ophiuræ (slender snake star-fishes) and encrusting corallines (Lepraliæ)."

Means of capture.—Frequently taken in wicker crab-pots, which it probably enters to eat the baits.

Breeding.—End of the summer or in the autumn months of August and September.

Hermaphrodites.—Cavolini and Cuvier have, after repeated examinations, described this fish as a true hermaphrodite, one portion of each lobe of roe being stated to consist of true ova, the other part having all the appearance of perfect milt, and both advancing simultaneously to maturity. Yarrell, however, having obtained some roe, examined it in conjunction with Professor Owen, and they observed nothing equivocal either in its structure or appearance.

Uses.—Albertus Magnus advises that its tongue and a small portion of its heart should be removed and then infused in water, and assures us that the mixture will cause a multitude of fishes to collect together. Likewise should you have a law suit, it should be placed under your arm and the judge will become your friend.

As food.—Seldom even brought to market, but usually cut up into baits. Still it is good eating, and said to be delicate, but too small to be of much value.

Habitat.—From the south and south-west coasts of England, also of France and Portugal and throughout to the Mediterranean. It has likewise been taken at Madeira, Teneriffe, as far south as the Cape of Good Hope, and the Island of St. Paul in the Southern Indian Ocean.

Although this fish is common at Plymouth, also at Mevagissey, in Cornwall, and was first observed by Couch at the intermediate locality of Polperro, it becomes rare at Penzance. Mr. Cornish observed in 1866, having obtained a specimen there, that it was only the second he ever saw from Mount's Bay

(Zoologist 1866, p. 348). It does not appear to extend to the Straits of Dover on the east, nor so high as the Bristol Channel on the west. It has not been recorded from Ireland.

It attains to at least a foot in length. The example figured, which is 10 inches long, was obtained at Mevagissey by Mr. Dunn.

2. **Serranus gigas**, Plate V.

Perca gigas, Brünnich. Pisc. Mass. p. 65, No. 81; Gmel. Linn. p. 1315.

Holocentrus gigas, Bl. Schn. p. 322; Rafin. Indice, p. 17; De la Roche, Ann. Mus. xiii, p. 318.

Holocentrus merou, Lacép. iv, p. 377; Risso. Ich. Nice, p. 289.

Serranus gigas, Cuv. and Val. ii, p. 270, pl. xxxiii; Yarrell, Brit. Fish. (Ed. 1) i, p. 15, c. fig. (Ed. 2) i, p. 14 (Ed. 3) ii, p. 132; Exp. Scient. Morée, Zool. Geoff. St. Hilaire, &c. 1832, pl. xvi, f. 1; Jenyns, Brit. Vert. p. 333; Guichen. Explor. Sc. Alger, 1850, Poiss. p. 35; White, Catal. of Brit. Fish. p. 11; Günther, Catal. i, p. 132; Steind. Ich. Span. & Port. 1867, p. 11, and SB. Ak. Wien, lxxiv, p. 175.

Perca robusta, Couch, Mag. Nat. Hist. v, p. 21, f. 7.

Serranus marginatus, Lowe, Pro. Zool. Soc. 1833, p. 142.

Serranus fimbriatus, Lowe, Trans. Cambr. Phil. Soc. 1836, p. 195, pl. 1; Val. in Webb and Berth. Ich. p. 8.

Serranus caninus, Val. l. c. p. 10.

Serranus cernioides, Brito Capello, Journ. d. sc. Math. &c. No. ii, p. 156 and No. iii, p. 12, Est. iv, f. 1.

Dusky Perch, Couch, Fish. Brit. Isles. i, p. 198, pl. xliii.

B. vii, D. $\frac{11}{15\text{-}16}$, P. 16-17, V. 1/5, A. $\frac{3}{8\text{-}9}$, C. 17, Cœc. pyl. 12 (19 to 20 C. V.) L. l. 120-130.

Length of head $3\frac{1}{4}$ to $3\frac{1}{2}$, of caudal fin $6\frac{1}{2}$, height of body $3\frac{2}{3}$ to 4 in the total length. *Eye*—diameter 6 to 7 in the length of the head, $1\frac{1}{4}$ to $1\frac{1}{2}$ diameter from the end of the snout, and 1 to $1\frac{1}{2}$ apart. Lower jaw the longer. The maxilla reaches to beneath the hind edge of the eye. Preopercle serrated, most coarsely so at its angle. Sub- and inter-opercles entire. *Teeth*—villiform in jaws, on vomer and palatines. *Fins*—dorsal spines of moderate strength increasing in length to the third, which equals nearly 1/2 the length of the head. Soft portions of dorsal and caudal rounded. *Scales*—ctenoid, about 12 rows between the base of the first dorsal ray and the lateral-line. *Colours*—reddish-brown on the back becoming lighter on the sides and beneath: two oblique lines on the gill-covers passing backwards and downwards.

Modes of capture.—Takes a bait: Couch's example, which was 3 feet long and weighed 19 lb., was thus obtained.

Breeding.—In warmer climates it deposits its ova in shallow water during the months of April and May.

As food.—It is held in some estimation in the countries to which it resorts.

Habitat.—This fish, of which occasional wanderers have been captured along the south coast of England, is found in the Mediterranean, also Madeira and as far south as the Cape of Good Hope, as well as on the eastern shores of North America, being plentiful and of large size at Rio de Janiero. Risso observes that it only visits Nice during the summer and autumn.

In the British Isles its captures have been almost confined to the south coast. It was first observed by Couch, one example having been taken at Polperro: two are recorded by Cock from Falmouth, one of which was sent to the British Museum: while Mr. R. Couch (Zool. 1846, p. 1401) remarked that the late Mr. E. Chirgwin informed him that two specimens had been caught in Mount's Bay, and observes that one if not more have been obtained at Penzance.

This fish attains to a large size, as up to 3 feet in length, and 60 lb. in weight, while a figure drawn natural size of the head of one captured at Penzance still exists, it is 16 inches long, which would make the example at least 52 inches in its entire length. I have to thank Professor Peters, Director of the Zoological Museum at Berlin, for the example which is figured.

Genus V.—Polyprion, *Cuvier.*

Branchiostegals seven: pseudobranchiæ present. Body oblong. Opercles denticulated, a serrated longitudinal ridge across the opercle, and others on the upper surface of the head and occiput. Teeth villiform in the jaws and on the vomer, palatine bones and tongue. A single dorsal fin with 11 *strong spines, anal with* 3. *Scales ctenoid, small. Pyloric appendages numerous.*

In appearance these fishes have a general resemblance to *Serrani* with the head like a *Scorpæna.*

Geographical distribution.—From the coasts of Norway to Britain, France and the Mediterranean: also Madeira and the Cape of Good Hope, while a large dried example was brought to Europe by the "Novara" from the Island of St. Paul in the Southern Indian Ocean. Forster recorded it from Queen Charlotte's Island, on the western shores of North America; and a few years since Steindachner described a new species, as *Polyprion Knerii*, from the island of Juan Fernandez, on the western coast of South America.

1. **Polyprion cernium**, Plate VI.

Amphibrion Americanus, Bl. Schn. p. 205, and *A. Australe*, t. xlvii.

Epinephelus oxygeneios, Bl. Schn. p. 301.

Scorpæna Massiliensis, Risso, Ich. Nice, p. 184 (not Lacép.).

Holocentrus gulo, Risso, Eur. Mèrid. iii, p. 367.

Sciæna aquila, Rosenthal, Ich. Taf. xvi, f. 1.

Polyprion cernium, Val. Mém. du Mus. xi, p. 265, pl. xvii; Cuv. and Val. iii, p. 21, pl. xlii and viii, p. 475; Yarrell, Brit. Fish (Ed. 2) i, p. 19, c. fig. (Ed. 3) ii, p. 124; Swainson, Fishes, ii, p. 203; Cuv. Règne Anim. Ill. Poiss. pl. ix, f. 1; White, Catal. p. 12; Günther, Catal. i, p. 169; Collett, Norges Fiske, p. 16; Kner, Voy. Novara Fische, p. 28; Steind. Ich. Span. u. Port. 1867, p. 15; Sauvage, Arch. de Zool. 1879-80, p. 12.

Serranus Couchii, Yarrell, Brit. Fish. (Ed. 1) i, p. 12, c. fig; Jenyns, Man. Brit. Vert. p. 334.

Perca scriba, Comide, Peces de Galicia, p. 57.

Stone-basse, Couch, Linn. Trans. xiv, p. 81, and Fish. Brit. Isles, i, p. 200, pl. xliv.

B. vii, D. $\frac{11}{11-12}$, P. 16-17, V. 1/5, A. $\frac{3}{8-9}$, C. 17, L. l. ca. 120, Vert. 13/13, Cœc. pyl. numerous.

Length of head from 3 to $3\frac{1}{2}$, of caudal fin 7 to $8\frac{1}{2}$, height of body 3 to $3\frac{1}{2}$ in the total length. *Eye*—comparatively much larger in the young than in the adult, $4\frac{1}{2}$ to $5\frac{1}{2}$ diameters in the length of the head, $1\frac{1}{4}$ to $1\frac{1}{2}$ diameters from the end of the snout. The maxilla extends to beneath the middle or (in large examples) hind edge of the orbit: lower jaw projecting beyond the upper. Nostrils patent, placed close together. A rough bony ridge ending in a spine, crosses the opercle. The posterior limb of the preopercle strongly serrated, with a cluster of several strong and irregularly placed spines at its angle, and some denticulations along its lower limb. Inter- and sub-opercles denticulated at their approximating angles. Preorbital denticulated. Supraorbital margin roughened, a ridge passes to the shoulder, while a short convex median one exists on the occiput. *Teeth*—villiform on the jaws, tongue, vomer, and palatine bones. *Fins*—all the spines and fin rays comparatively longer in the young than in the adult: dorsal spines strong, increasing in length to the 5th, the next 3 being almost equally long, from the 8th they decrease, but the 11th is slightly longer than the 10th: dorsal rays half higher than the spines. Ventral spine roughened externally. Third anal spine somewhat the longest, the two first rough anteriorly, while the rays are half longer than the spines. Caudal rounded. *Gill-rakers*—most developed in the anterior branchial arch, the outer limb of which contains about twelve, the longest nearly one diameter of the orbit in length. *Scales*—small, strongly ctenoid, some are extended over a portion of the soft dorsal and anal fins, also on

the base of the caudal and between the rays. *Cœcal appendages*—in the example figured they were numerous, three or more springing from one root and soon dividing; Valenciennes states that there are only two, one of which is very short and the other very long, but I found upwards of seventy in the single example I dissected. *Colours*—of a grayish-brown or stone colour, irregularly marbled or with large light blotches, which become less visible in the adult. Fins dark, almost black, while the caudal in the adult has a light outer edge.

Names and their origin.—Schneider gave *Americanus* as the specific name of this fish, which was described and figured from a drawing sent him by Dr. Latham, who stated the native habitat was America. It is called in Devonshire, *Wreck fish*, because it follows floating timbers. The term *Stone-bass* employed by Couch was originally given by Sloane to a *Pagrus* from Jamaica adverted to by Ray (p. 132): Lowe states it to be called *Jew-fish* by the English in Madeira, where the natives term it *chernotte* if small, *cherne* when large.

Habits.—This appears, as a rule, to be a fish living in deep waters, and Couch observes that when a piece of timber covered with barnacles, *Lepades*, is brought by the currents from the more southern regions which these fish inhabit, considerable numbers of them sometimes accompany it. In the Mediterranean it is found to be solitary, frequenting deep waters having a rocky bottom. Mr. Holdsworth observed "the crew of the 'Providence' smack found a large log of mahogany in Start Bay, covered with long barnacles and surrounded by a shoal of these fish. They jigged (*i.e.*, caught with a pole having a barbed hook at the end) 4 or 5." Ships having foul bottoms in water where they abound and covered with barnacles, are followed by shoals of these fishes when becalmed. It feeds on molluscs and small fishes. Valenciennes found sardines in the stomach of one he dissected.

Means of capture.—Couch says that when a mass of wreck floats in sight of a ship in the northern part of the Atlantic, and the weather is favourable, a boat is often despatched to obtain some of these fish, which is effected by piercing them with a spear known as grayns. As many as 35 have been secured at one time by a single boat on our own coast.

Breeding.—In the summer in the Mediterranean according to Risso.

Hermaphroditism.—Professor Rolleston showed me at Oxford an example which had the roe white in its superior two-thirds, while in its lower third it was of a brown colour and distinct from the upper. The appearance externally was such as might be anticipated in a hermaphrodite, but the microscope failed to prove it to be one.

Diseases.—Risso states that this fish is tormented with numerous filiform parasites of a reddish colour, which inhabit its intestines, causing it to possess an insatiable appetite.

As food.—Reputed to be excellent, the flesh being white, tender, and of a good flavour.

Habitat.—From the seas of Norway to the British Isles, and the coasts of France and Portugal to the Mediterranean, where it remains through the whole year. It is common at Madeira, extending to the Cape of Good Hope, and the Island of St. Paul's, in the Southern Indian Ocean. It has also been recorded by Forster as *Perca prognathus*, locally termed *patò-térà*, from Queen Charlotte's Isle on the western shores of North America.

It was first obtained in British waters by Couch, who observes that on the south and west coasts of England it is well known to the fishermen. It is occasionally found in deep water off Cornwall: is not uncommon in the Bristol Channel (Baker of Bridgewater) or on the Devonshire coast (Holdsworth). In the year 1845 it was reported as common between the Scilly Isles and Land's End. It has been taken at Dingle Bay in Ireland where it was captured August 2nd, 1847, in a floating meal-barrel (Moore).

This fish attains to over 6 feet in length. Mr. Cornish (Zool. p 424) obtained one at Penzance, August 24th, 1878 more than 20 inches long. The largest seen by Couch weighed 20 lb. The specimen figured is 7½ inches long, and I am indebted for it to Professor Hubrecht of Leyden.

Genus VI.—Dentex,* *Cuvier.*

Gymnocranius, pt. Klunzinger: *Paradentex*, pt. Bleeker and *Synagris* (Klein) Bleeker.

Branchiostegals six or seven: pseudobranchiæ present. Body oblong, rather elongated, and a little elevated. Eyes of medium or rather large size. Mouth moderately protractile, its cleft more or less horizontal: jaws of about equal length. Preopercle entire or feebly serrated: opercle without any or with a not very prominent spine: the distance between the eye and the angle of the mouth considerable. Generally strong canines, from 4 to 6 in number, in the front part of both jaws, almost invariably in the upper: a conical outer lateral row in either jaw: vomer, palatines, and tongue edentulous. One scaleless dorsal fin, having from 10 to 13 spines: anal with 3 and from nine to eleven rays: spines generally weak and more or less receivable into a scaly groove: caudal forked. Scales ctenoid, of moderate size: more than 3 rows between the eye and the angle of the preopercle: none on the front of the snout, jaws, or preorbital. Air-bladder simple, not constricted but notched posteriorly. Pyloric appendages few.

This genus has been divided into those with more than 3 rows of scales across the preopercle *Dentex*, and such as only have 3 rows, *Synagris*. Even thus restricted it has been further subdivided into *Gymnocranius* or *Paradentex*, being those forms wherein the scales do not extend forwards on to the upper surface of the head so far as the eye, the upper jaw is more protractile and the canines are weaker.

These fishes were included among the Sparoids by Cuvier, with which their habits have perhaps more analogy than with the true sea Perches.

Geographical distribution.—Occasional wanderers have been taken on the south coast of England, while they are found through the Mediterranean, the Atlantic, Indian and North Pacific Oceans, also the Red Sea.

1. Dentex vulgaris, Plate VII.

Dentex, Colum. viii, c. 16; Jonston, lib. i, t. iii, c. 1, art. vi, p. 69, t. xviii; Gesner, 1598, f. 26, c. fig.; Willughby, lib. iv, c. xiii, p. 312, t. V. 3; Ray, p. 132.

Synagris, Belon. p. 181; Salv. p. 111; Rondel. v. c. 19, p. 150 c. fig.; Aldrov. lib. iv, t. 166.

Cynœdus, Gronov. Zooph. p. 60, No. 214.

Sparus Jonsoni, Walb. Artedi, 1792, iv, p. 302.

Sparus dentex, Gmel. Linn. p. 1278; Bonnaterre, Ency. Ich. p. 102, pl. l, f. 190; Bloch, t. cclxviii; Shaw, Zool. iv, pt. 2, f. 408; Donovan, Brit. Fish. iv, pl. lxxiii; Lacép. iv, p. 121; Turton, p. 98; Risso, Ich. Nice, p. 253; De la Roche, Ann. Mus. xiii, p. 317; Duhamel, Pêches, ii, c. 2, p. 251.

Cichla dentex, Bl. Schn. p. 337.

Sparus gibbosus, Rafin. Caratteri, 1810, p. 47, No. 126 (*adult*).

Sparus cetti, Risso, Ich. Nice, p. 256.

Dentex cetti. Risso, Europ. Mérid. iii, p. 256.

,, *vulgaris*, Cuv. and Val. vi, p. 220, pl. cliii; Flem. Brit. Anim. p. 212; Jenyns, Man. p. 357; Yarrell, Brit. Fish. (Ed. 1) i, p. 111, c. fig. (Ed. 2) i, p. 127 (Ed. 3) ii, p. 153; Guichen. Explor. Algér. Poiss. p. 51; Val. in Webb and Berthel. Iles Canar. Poiss. p. 36; Günther, Catal. i, p. 366; Steind. Ich. Spanien u. Port. 1867, p. 22.

Dentex gibbiceps, Reuss, Isis, 1832, p. 626 (*adult*).

Dentex Johnsoni, White, Catal. Brit. Fish. p. 19.

* *Huro nigricans* or the Black Bass from the Delaware river, America, has been extensively introduced by the Marquis of Exeter into the waters of his estate at Stamford, where they may be acclimatized and widely spread. About 965 appear to have been landed alive, and their average weight is now (Oct. 1880) about half a pound each.—*Land and Water*, Oct. 16th, 1880.

Dentex, Couch, Fish. Brit. Isles, i, p. 203, pl. xlv.

B. vi, D. $\frac{10-11}{12-11}$ P. 15, V. 1/5, A. $\frac{3}{8}$, c. 17, L, l, 60-65, L, tr. 8/17, Cœc. pyl. 5, Vert. 10/14.

Length of head $3\frac{2}{3}$ to $3\frac{3}{4}$, of caudal fin 5 to $5\frac{1}{2}$, height of body $3\frac{1}{4}$ to $3\frac{1}{3}$ in the total length. *Eye*—comparatively much larger in the young than in the adult, $4\frac{1}{4}$ to $5\frac{1}{2}$ diameters in the length of the head, $1\frac{1}{2}$ to $2\frac{1}{2}$ diameters from the end of the snout, and 1 to $1\frac{1}{2}$ diameters apart. Jaws of about the same length anteriorly, the maxilla reaches to beneath the front edge of the eye. Nostrils patent, the posterior the larger. Preorbital large, its height in the young equalling about 1 diameter of the orbit, but in the adult from $1\frac{3}{4}$ to even 2 diameters: it is about 1/4 longer than high. Bones of the head entire. *Teeth*—4 large curved canines in either jaw, the outer pairs much the strongest, while there is an inner row of small teeth: laterally a row of pointed ones: none on the tongue, vomer, or palatine bones. *Fins*—spines of dorsal weak, increasing in length to the 4th or 5th which equals half the length of the head and rather exceeds that of the longest ray. Pectoral nearly as long as the head. Third anal spine rather longer than the second. Caudal forked. *Scales*—finely ctenoid, 8 rows between the eye and the angle of the preopercle, which likewise has a few scales, irregularly placed, along its limb. *Colours*—it may be beautifully varied, being silvery interchanged with light blue on the back and some blue spots on the sides. On the front of the head wavy lines of gold, silver, and purple: eyes blue with a golden iris. Dorsal fin bluish-yellow, pectoral and caudal reddish. One form of colour, which may be due to age, is the existence of a large yellow spot at the base of the opercle, and extending over the interopercle. The variety, *D. cetti*, was examined by M. Laurillard at Nice, and he found the spot well marked in the adult, but absent from the immature.

Names and their origin.—*Cynodon* or "dogs' teeth" refers to its large canines, the term *four-toothed gilt head* has a similar origin.

Habits.—Exceedingly voracious and a rapid swimmer. During the winter it retires to the deeper water, but about June seeks the shallower places, approaching the mouths of rivers where it deposits its ova between the crevices of stones and rocks.

Means of capture.—Large fisheries of the *Dentex* are carried on in the warmer European climes.

As food.—Palatable and wholesome when fresh, while it salts well. It is prepared by cutting in slices and packing in barrels with vinegar and spices: thus treated it keeps for months.

Habitat.—From the south coast of England to the Mediterranean and the Canary Isles.

Edward has mentioned an example from Troup Head in Banffshire. The first example obtained in this country was received by Pennant from Billingsgate, it had been captured at Hastings, April 9th, 1805, and weighed 16 lb. Mr. Cocks recorded two more in Couch's work, one of which was $32\frac{1}{2}$ inches in length, which he purchased in the fish-market at Falmouth in November, 1846: the second was obtained from the same place in August, 1851, and measured 56 inches.

This fish attains a large size. Duhamel observes that it may weigh 70 lb. For the example figured, life-size, I am indebted to Professor Peters, Director of the Berlin Zoological Museum.

Family II.—MULLIDÆ, *Swainson.*

Branchiostegals four: pseudobranchiæ present. Body rather elongated. Profile of head more or less parabolic. Eyes lateral, and of moderate size. Mouth rather small, having a lateral cleft. Two stiff barbels below the chin belonging to the hyal apparatus. Teeth feeble and variously placed in the jaws and mouth. Two dorsal fins, situated at some distance asunder: the anal similar to the second dorsal: ventral with one spine and five rays. Scales large, feebly ctenoid, and rather deciduous. Air-bladder, when present, simple. Pyloric appendages few or in moderate numbers.

Geographical distribution.—Seas of the temperate portions of Europe as well as in most of those of the tropics: more numerous in the eastern than in the western hemisphere. Many young and some adults of exotic species have been captured in rivers.

Genus I.—Mullus, *Linnæus.*

Definition as given for the Family. Teeth in the lower but none in the upper jaw: present on the vomer and palatine bones.

Geographical distribution.—From Scandinavia through the seas and coasts of temperate Europe, the Mediterranean, the Adriatic, and the Black Sea: also at least as far south in the North Atlantic Ocean as Madeira and the Canary Isles.

Termed *Triglé* by the Greeks, from ancient times until the present, under the supposition of their breeding three times yearly or else according to Athenæus that they only breed three times throughout their entire existence, their internal organs being subsequently destroyed by parasitic worms. It was dedicated by the Greeks to the triple-eyed goddess Hécate or Diana. The designation by the Romans is said to have been changed to *Mullus*, framed, it has been supposed, on their colour, which resembled that of the sandals worn by the Alban kings, and subsequently by the Roman consuls, and which were afterwards adopted by their emperors under the designation of *Mulleus.*

In the time of the Cæsars the Mullets seem almost to have divided with them the allegiance of the Roman people, all of whom sought to obtain the fish for their repasts as a luxury of no common order and the ruling fashion of the time. When Rome could no longer supply them in sufficient quantity they were imported from elsewhere, especially Corsica and Sicily. Salt water vivaria were constructed at enormous expense wherein they were kept, but Columella observes that scarcely one in several thousand survived the transfer, which mortality he ascribed to their nobility spurning confinement. Kept in the salt water ponds they were carefully tended and taught to know their owner and come to be fed when their respective names were called out. Here care was taken that by judicious feeding they did not become emaciated, but it was observed that they never increased in size. Seneca states that when the time had arrived for presenting them at their owners' feast they were most valued if they expired in the presence of the guests. Introduced in glass globes they were drowned in piquant sauces or slowly boiled on the banqueting table before the company who were thus able to view in comfort the varied and beautiful changing hues of the expiring fish. Did it appear likely to burst during the process of cooking, skilful cooks are said to have hindered this catastrophe by kissing the mullet's mouth!

These fishes realized high prices in Rome, due to the estimation in which they were held, or the notoriety gained by the purchaser who paid the most excessive sum: while the larger they were the more they were valued as being obtained with greater difficulty. It is said that about the time of Horace they had attained to the maximum of their glory. Martial informs us that the price of a 4½ lb. fish was ruinous: one of 6 lb. produced a sum equivalent to £48; and Asinius Celer, an official who had attained consular dignity, paid £64. 11*s* 8*d* for one still larger: while even £240 was realized for an example of unusual size procured on the day of a grand feast. A Roman is reputed to have disposed of a valuable slave in order that with the proceeds he might for once indulge in eating a mullet: as

Juvenal remarks, the fisherman could have been purchased for less than his fish. But as time went on the abnormal value of the mullet declined, until in the fourth century, Macrobius assures us that it was not excessive.

1. Mullus barbatus, Plate VIII, fig. 1.

Τρίγλη Arist. ii, c. 17, iv, c. 11, v, c. 9, vi, c. 17, viii, c. 2 and 13, ix, c. 2 and 37; Ælian, ii, c. 41; Athen. vii, pp. 324, 325.

Mullus, Ovid, v. 123; Pliny, ix, c. 17, 18, 51; Martial, x, ep. 30, 31, xi, ep. 50; Colum. viii, c. 17; Belon. 170. *Triglia*, Salv. fol. 235. *Mullus minor*, Jonston, lib. i, t. iii, c. 1, art. 1, p. 61, t. xvii, f. 5. *Mullus Belonii*, Willughby, p. 285, t. S. 7, f. 2; Ray, p. 90. *Mullus barbatus*, Rondel. ix, c. 4, p. 290, c. fig.; Gesner, Aquat. p. 565. *Mullus*, Gronov. Zooph. p. 85, No. 286. *Trigla*, No. 1, Artedi, Genera, p. 43, Synon. 71.

Surmullet, Pennant, Brit. Zool. (Ed. 1) iii, p. 271 (Ed. 2) iii, p. 265.

Mullus barbatus, Linn. Syst. Nat. i, p. 495; Bonnaterre, Ich. p. 143, pl. lix, f. 232; Bloch, t. 348, f. 2; Gmel. Linn. p. 1338; Bl. Schn. p. 79; Shaw, Zool. iv, p. 611; Mart. Reise nach Venedig. ii, p. 426; Turton, p. 101; Cuv. and Val. iii, p. 442, pl. lxx; Yarrell, Brit. Fish. (Ed. 1) i, p. 32, c. fig. (Ed. 2) i, p. 36 (Ed. 3) ii, p. 102; Jenyns, Brit. Vert. p. 338; Swainson, Fishes ii, p. 234; Johnston, Berwick. Nat. Club, 1838, i, p. 170; Nord. in Demid. Voy. Poiss. p. 373; White, Catal. Brit. Fish, p. 14; Günther, Catal. i, p. 401; Steindach. Sitz. Ak. Wiss. Wien. 1867, lvi, p. 635 or Ich. Spanien u. Port. 1867, p. 33.

Red Mullet, Couch, Fishes Brit. Isles, i, p. 217, pl. xlvii.

Variety Mullus surmuletus, Plate VIII, fig. 2.

Mullus. Pliny, Hist. Mund. ix, c. 17; Belon. Aq. p. 176. *Mullus major*, Salv. fol. 236; Aldrov. Pisc. p. 123; Jonston, De Pisc. lib. i, t. iii, c. 1, art. 1, p. 61, t. xvii, f. 6; Willugh. p. 285, t. S. 7, f. 1; Ray, p. 91. *Trigla*, No. 2, Artedi Genera 43, Syn. 72. *Mullus barbatus*, Klein, Mss. 5, p. 22. *Striped surmullet*, Pennant, Brit. Zool. (Ed. 1) iii, p. 274, pl. liii (Ed. 2) iii, p. 368, pl. lxiv.

Mullus surmuletus, Linn. Syst. i, p. 496; Bonnaterre, Ich. p. 144, pl. lix, f. 233; Bloch, t. lvii; Shaw, Brit. Zool. iv, p. 613, pl. lxxxviii; Brünn. Pisc. Mass. p. 71; Gmel. Linn. p. 1339; Lacép. iii, p. 394; Bl. Schn. p. 77; Donovan, Brit. Fish. i, pl. xii; Martens, Reise nach Venedig. ii, p. 427; Turton, p. 102; Cuv. and Val. iii, p. 433; Cuv. Règne Anim. Ill. Poissons, pl. xix, f. 2; Yarrell, Brit. Fishes (Ed. 1) i, p. 27, c. fig. (Ed. 2) i, p. 31 (Ed. 3) ii, p. 97; Flem. Brit. An. p. 216; Jenyns, Manual Brit. Vert. p. 337; Guichen. Explor. Sc. Algér. Poiss. p. 38; White, Catal. Brit. Fish. p. 14; Thompson, Nat. Hist. Ireland, iv, p. 70; Günther, Catal. i, p. 401; Collett, Norges Fiske, p. 17.

Mullus barbatus, De la Roche, An. Mus. xiii, p. 316; Gronov. ed. Gray, p. 108.

Surmullet, Couch, Fish. Brit. Isles, i, p. 208, pl. xlvii.

B. iv, D. 7-8 | $\frac{1}{8}$, P. 16-18, V. 1/5, A. $\frac{2}{6}$, C. 15, L. l. 38-40, L. tr. $\frac{2\frac{1}{2}\text{-}3\frac{1}{2}}{6\text{-}7}$, Cœc. pyl. 18-22, Vert. 10/14.

Length of head 4 to $4\frac{1}{2}$, height of body $3\frac{3}{4}$ to $4\frac{1}{2}$, length of caudal fin $4\frac{1}{2}$ to 5 in the total length. *Eye*—high up, $1\frac{1}{2}$ to 2 diameters from the end of the snout, $1\frac{1}{2}$ diameters in the postorbital portion of the head, and 1 to $1\frac{1}{3}$ diameters apart. Profile of forehead more or less steep, in some examples descending almost vertically. Preorbital much higher than broad—sometimes nearly twice as much. The posterior extremity of the maxilla reaches to beneath the anterior edge of the orbit: snout, preorbital and cheeks covered with open pores. *Barbels*—well developed, and reaching to beneath the hind edge of the preopercle. *Teeth*—in about 2 rather obtuse rows in the lower jaw, none in the upper. Rounded teeth on vomer and palatine bones. Tongue toothless. *Fins*—spines of first dorsal flattened and weak at their extremities, the first spine very short (apt to be overlooked), the second, third and fourth of about the same length and equalling 2/3 the length of the head: subsequently the spines decrease in length. An interspace of about four scales between the two dorsal fins. Second anal spine much the longer. *Intestines*—the length of the intestinal tract from the pylorus

to the vent equals half that of the entire fish excluding the caudal fin. The pyloric appendages consist of some short and other long ones. *Scales*—when at Mevagissey, in August this year, Mr. Dunn procured for me some splendid examples of this fish, and although the majority had $2\frac{1}{2}$ rows of scales between the lateral-line and the back, others had $3\frac{1}{2}$. *Lateral-line*—the tubes are much branched. *Colours*—these vary considerably: in the *M. barbatus* the fish being of a plain red colour, whereas the *M. surmuletus* is more or less longitudinally striped, which stripes may be sometimes concealed, while the rich satin-red colour becomes most vivid after the removal of the scales.

Varieties.—Gronovius considered the *Mullus barbatus* as the male and *M. surmuletus* as the female of a single species: but most subsequent authors considered them as specifically distinct. During the last few years it has been advanced that the two are varieties of one form. The distinctions given, and which still pertain to some examples, are as follows:—

M. barbatus.—The profile of the snout almost vertical, more so than in the *M. surmuletus.* It is red without any longitudinal stripes, and Yarrell considered the position of the fins differed a little, the first dorsal being said to be more in advance of the pectoral fin and the ventral further behind than in the surmullet: he gives one yellow band along the side below the lateral-line. This form is reputed never to attain the size of the surmullet, and it has been conjectured that they become more striped with age.

M. surmuletus.—Has generally an oblique profile of the snout. It is of a pale pink becoming yellowish on the sides and along the abdomen: while from three to five bright yellow bands pass from the head along the sides, the two central ones reaching the base of the caudal fin, one above, the other below the lateral-line. First dorsal fin with two longitudinal dark bands, the upper being nearly black and placed on a milk-white ground. Second dorsal with two or more oblique dark bands, and occasionally the caudal fin is also obliquely banded. The outer edges of the scales are often darker than their bases.

Professor Steindachner observes that he had examined not less than 75 examples and found so many variations in the form of their rostral profiles that he felt compelled to consider the *M. barbatus* and *M. surmuletus* as the extreme limits of variation of a single species.

Names.—The *M. barbatus* is known as the *red surmullet*, the *plain red mullet*, or in Welsh *Hyrddyn coch.* The *M. surmuletus* is termed *surmullet* or *striped red mullet. De koning van de poon*, Dutch. *Rouget-barbet*, French.

Habits.—These fishes along the southern coast are found in Cornwall at about 20 miles out to sea in March, and from 5 to 10 in May, when they come in with the mackerel, and are said to be of a roving disposition, About the end of June they arrive close in shore on sandy spots which are near to rocks, and as soon as startled they dash in among them or under the sea weed. The best and finest coloured ones are in the west portion of the channel dividing England from France.

But as might be anticipated, we find occasional visitors on our coasts when least expected, thus on December 24th, 1878, Mr. Cornish obtained one 16 inches long and in good condition at Penzance: and in June 1866 one was captured in a drift net 15 leagues south-west of Scilly in about 60 fathoms water: and Couch alludes to a trawl vessel of Plymouth which one winter took so many of these fishes that they realized £20. As to the food they eat, opinions vary: the ancients considered them very foul feeders, delighting mostly on corpses, the more putrid they become the larger the assemblies of these fish: the ocean after a sea battle was said to abound with them. It is more probably they devour small crustacea, crabs, molluscs, &c. In an aquarium they eat pieces of mussel,

Means of capture.—Ground seines, trammels, trawls and mullet nets. Dr. Bullmore observes that at Penzance, on their first appearance, they are mostly captured in trawls, at the next spring-tides they become more abundant and are taken in ground seines, sometimes as many as 50 or 60 in a night. At Mevagissey the trammel is formed of three parts fastened by a common head-line and footline. The meshes of the middle piece will only receive the head and shoulders of the fish, while the outermost pieces will allow the entrance of the mullet's body so

far as its middle. These are set in accordance with certain inshore marks known to the fisherman. The foot rope must touch the bottom or the fish will pass under it. The reason they are occasionally taken in drift nets is assumed to be that when changing their locality they swim near the surface even if the water is very deep. Occasionally they take a bait.

Immediately one is captured, or as soon as landed, the scales are stripped off by the thumb nail, which occasions a contraction of the pigment cells, for were this not done the brilliant red colour observed in the fishmongers' shops would be less apparent and the fish of less value for the table. Irrespective of this, were the scales not so removed, and the fish to dry, as it would, while in transit to the market, they (the scales) become very adherent, and are with some difficulty removed without breaking the skin, which would occasion disfigurement. Those caught in a trammel being less bruised than such as are taken in a trawl keep longer and are more valued.

Breeding.—In Britain the striped surmullets, both male and female, are met with spawning along the south coast from July to September. Mr. Dunn observes that "they shed only a little at a time, continuing their spawning probably over a month, and different from all other fish I know. They get very fat at this time." By October there are young, about 2 inches in length, and from one eighth to one quarter of an ounce in weight.

As food.—This fish is held in high estimation throughout most of Continental Europe as well as in this country. In France the plain red mullets of Provence and Toulon are most valued, while in Britain the finest examples of *Surmullets* are obtained from the English Channel. Its flesh is of good flavour, white, firm, flaky, destitute of fat and easy of digestion. It attains its highest perfection during the summer months, but is seen throughout the year in London fishmongers' shops. Its liver is usually deemed its most savoury morsel, to which its head was formerly considered next in delicacy.

This fish when cooked is usually not opened, only its gills being removed, on which account it is termed the "woodcock of the sea," it is closely wrapped up in a sheet of buttered paper securely tied with packthread. It is then roasted in a Dutch oven, or gently broiled over a clear fire, or baked for 20 or 25 minutes. For sauce the liquor which exudes is added to melted butter, some essence of anchovy and a little lemon juice. A glass of port-wine or claret may be used as an addition. In Venice it is eaten soused: the fish is kept soaking some time in a pickle of capsicum vinegar before being eaten.

Habitat.—From Scandinavia through the seas and coasts of temperate Europe. While in the North Atlantic it extends as far south as Madeira and the Canary Isles. It also abounds in the Mediterranean, Adriatic, and is found in the Black Sea. The most abundant form in the Mediterranean appears to be the *M. barbatus*, while the larger striped variety, *M. surmuletus*, is common in the North Atlantic.

In England the surmullet is most numerous along the south and west coasts, rapidly decreasing in numbers as we go northwards, still in some seasons they are abundant off the county of Norfolk; thus in 1831 during one week in May 10,000 were despatched from Yarmouth to London (Paget).

In Scotland Pennant stated he had heard of its capture but did not see the fish: it has been recorded from the Moray Frith (Gordon), and both it and the plain red mullet from Banffshire (Edward).

The plain red mullet has been taken in Berwickshire (Johnson) and at Falmouth (Cock). Mr. Dunn at Mevagissey tells me that he has never seen an example during the many years he has been engaged on fish and fishing.

In Ireland the surmullet was included among the indigenous fish by Brown in 1774: it has also been taken in Ventry Harbour (Andrews); Dublin Bay (Warren); Ballinskelligs Bay (Earl of Ducie).

The usual size of this fish is from 1 to 2 lb., and about 14 inches in length; but an example has been recorded from Penzance taken in a trammel in October, 1875, and which was $16\frac{3}{4}$ inches long, and weighed 2 lb. $6\frac{1}{2}$ oz. (Cornish), while Yarrell records one of 3 lb. 6 oz. taken at Weymouth. At Mevagissey it has likewise been captured 17 inches in length.

Family, III—SPARIDÆ, *Cuvier.*

Branchiostegals from five to seven: pseudobranchiæ well-developed. Body oblong and compressed. Eyes of moderate size, lateral. Mouth in front of snout, having a lateral cleft. Bones of the head with a rudimentary muciferous system. No teeth on the palate (except in the Genus *Pimelepterus*): more or less broad and cutting or conical teeth in front of the jaws, or a lateral series of molars, or both conjoined. A single dorsal fin formed by a spinous and soft portion, their bases being of nearly equal extent: anal with three spines: lower pectoral rays branched in most of the genera: ventrals thoracic, with one spine and five rays. Lateral-line continuous, not extending on to the caudal fin. Scales cycloid, or feebly ctenoid.

Geographical distribution.—Seas of temperate and tropical regions. Some enter fresh waters.

SYNOPSIS OF BRITISH GENERA.

First group—Cantharina.

Broad and cutting teeth in front of the jaws: no molars: palate edentulous. Lower pectoral rays branched.

1. *Cantharus.* Cardiform teeth, with the outer row slightly compressed and lanceolate. Cheeks scaly: vertical fins scaleless.
2. *Box.* A single row of notched and trenchant teeth in both jaws. Cheeks scaly: vertical fins scaleless.

Second group—Pagrina.

Cutting teeth in front of the jaws; and molars along the sides.

3. *Pagrus.* Scales on cheeks. Canine teeth: two rows of molars in the upper jaw.
4. *Pagellus.* Scales on cheeks. No canine teeth.

First group—Cantharina.

Broad and cutting teeth in front of the jaws: no molars: palate edentulous. Lower pectoral rays branched.

Genus I.—Cantharus, *Cuvier and Valenciennes.*

Branchiostegals six: pseudobranchiæ present. Villiform or cardiform teeth in the jaws, those forming the outer row being compressed and lanceolate. Cheeks scaled. Dorsal fin with 10 *or* 11 *spines, which can be received into a scaly sheath. Scales of moderate size. Pyloric appendages few. Air-bladder divided posteriorly into two horns.*

Geographical distribution.—From Scandinavia and the British Isles, through the Atlantic Ocean to the Cape of Good Hope and the Seychelles. Also extended throughout the Mediterranean.

1. Cantharus lineatus, Plate IX.

Cantharus, Rondel. lib. v, c. iv, p. 120, c. fig.; Gesner, 1598, fol. 22, c. fig.; Aldrovand. 2, c. 20, p. 185; Jonston, lib. i, t. iii, c. 5, art. 11, p. 72, t. xix, f. 5; Willugh. lib. iv, c. viii, p. 309, t. v. f. 2; Ray, p. 130; Rutty, Dublin, i, p. 368. *Bréme de Mer*, Duhamel, pt. 2, sect. iv, pl. iv, f. 1.

Sparus cantharus, Gmel. Linn. p. 1274; Bl. Schn. p. 17; Duhamel, Pêches, ii, Sect. iv, pl. vii, f. 1; Swainson, Fishes, ii, p. 223.

Sparus brama, Bloch, v, p. 77.

Sparus lineatus, Montagu, Mem. Wern. Soc. ii, 1815, p. 451, pl. xxiii.

Sparus vetula, Couch, Trans. Linn. Soc. 1822, xiv, p. 79.

Sparus sciandra, Rosenth. Ich. Taf. t. xiv, f. 1.

Pagrus lineatus, Flem. Brit. Anim. p. 211.

Cantharus vulgaris and *brama*, Cuv. and Val. vi, pp. 319, 328, pl. clx; Guichen. Explor. Sc. Alger. Poiss. p. 53, and Ex. Sc. Morée, Zool. pl. xvii, f. 1, *a. b.*

Cantharus griseus, Cuv. and Val. vi, p. 333; Jenyns, Brit. Vert. p. 358; Yarrell, Brit. Fish. (Ed. 1) i, p. 114, c. fig. (Ed. 2) i, p. 130, (Ed. 3) ii, p. 156; Lowe, Trans. Zool. Soc. ii, p. 178.

Cantharus lineatus, Thompson, Ann. and Mag. (2), 1846, p. 313, and Nat. Hist. Ireland, iv, p. 91; White, Catal. Brit. Fish. p. 16; Günther, Cat. i, p. 414 Steind. Ich. Spanien u. Port. 1867, p. 47; Collett, Norges, Fiske, p. 17.

Old wife, Couch, Fish. Brit. Isles, i, p. 222, pl. xlix.

B. vi, D. $\frac{11}{12}$, P. 14, V. 1/5, A. $\frac{3}{10}$, C. 17, L. l. 72, L. tr. 9/19, Cœc. pyl. 4, Vert. 10/14.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin $5\frac{1}{2}$ to 6, height of body $2\frac{1}{2}$ to 3 in the total length. *Eye*—3 to $3\frac{1}{2}$ or in some large examples even 4 diameters in the length of the head, 3/4 to 1 diameter from end of snout, and 1 apart. Body compressed. The posterior extremity of the maxilla reaches to beneath the front edge of the orbit. Posterior edge of preopercle finely roughened. Opercular spine distinct. Lower edge of preorbital usually notched by the maxilla, but sometimes entire. *Teeth*—cardiform in both jaws, with the outer row somewhat the largest and slightly compressed; none on the vomer, palatines, nor on the tongue. *Fins*—dorsal spines of moderate strength, increasing in length to the fourth and fifth. Pectoral as long as or slightly longer than the head. Anal spines shorter than the rays. Caudal forked. *Scales*—ctenoid, about 8 rows below the eye over the cheek; 16 rows between the lateral-line and base of ventral fin. *Cœcal appendages*—four, rather large. *Air-bladder*—ending posteriorly in two horns, which are separated one from the other by the interhæmal spines. *Colours*—gray, becoming lighter and dashed with gold on the sides and beneath: forehead and cheeks purplish. Below the lateral-line are 3 or 4 parallel, or sometimes irregularly horizontal golden bands, along the body. Dorsal fin dark, with 2 or 3 nearly black bands composed of spots. Pectoral, caudal, and anal straw-coloured. Caudal gray-edged, margined externally with white: some bands of spots along the anal. Ventrals slate-colour along the centre, with light or even white edges. The colours in these fish are liable to considerable variation.

Names.—Black sea-bream: old wife. Rutty observes that in the county of Dublin it was "vulgarly but improperly termed *sea tench*," but it is questionable whether he referred to this fish.

Habits.—Prefers rocky ground, feeding on the finer kinds of sea weeds. It is found in bays and harbours, and frequently captured by anglers fishing from the shore, rocks or piers. Cuv. and Val. observe that the remains of *Fuci* were detected in it. It is most abundant about July and August, after which it appears to retire to deeper water. Couch records an example captured as late in the year as Christmas, after a cold season, and a second in February with the roe well developed. In aquaria they are fond of shrimps.

How captured.—Generally in summer and autumn by baits, as lob worms or pieces of mussel, or nets.

As food.—Its flesh is usually soft and little esteemed, but those taken in August and September at Boulogne and Calais are said to have firmer flesh and a moderately good taste.

Habitat.—Rare off the coasts of southern Norway, Ireland and Scotland, but becoming more common along the west and south coast of England and in the North Atlantic Ocean to Madeira and the Canary Islands: while it also abounds throughout the Mediterranean.

This fish was first recorded in Britain by Colonel Montagu in 1815, as *Sparus lineatus*, it is distributed along the entire south and up a portion of the west coasts of England; rarely in companies, but usually more solitary in its habits. In the Westminster Aquarium, however, I observe that they constantly swim together in companies. In Banffshire "a few of them are generally procured every autumn or about the beginning of winter" (Edward).

Ireland.—May, 1846, the first example recorded of late years,was captured by a hand-line baited with a lug-worm in Belfast Bay. Thompson says it had D. 10/11, A. 1/11, and the upper caudal lobe the longer. Another was taken in November at Kilmore, in the County of Wexford. While Rutty remarks "found about the rocks of Bullock, Dunleary, and Killeny Bay."

As to the size it attains, Couch mentions one of 16 inches in length: and Yarrell one of 17 inches, while it has been taken up to 20 inches. Mr. Cornish states that one 7½ inches in length was taken at Penzance, May 24th, 1880, and adds that he had not seen so small an example since May 26th, 1859.

Genus II.—Box, *Cuvier and Valenciennes.*

Boops, Cuvier.

Branchiostegals six: pseudobranchiæ present. Body elongated and somewhat rounded. A front row of incisors, having notched margins, in either jaw: no molars. Spines of dorsal fin (11 *to* 15) *can be received into a scaly sheath. Scales of moderate size, extended over the cheeks. Intestinal tract convoluted and rather long: pyloric appendages few. Air-bladder divided posteriorly into two horns.*

Geographical distribution.—From the southern coast of the British Isles southwards to Madeira and the Cape of Good Hope, also throughout the Mediterranean. Found in the Caribbean Sea in the West Indies.

1. **Box vulgaris,** Plate X.

Box, Plin. xxii, c. 11; Belon. de Aquat. p. 230. *Boops*, Rondel. v, c. 11, p. 136, c. fig.; Gesner, p. 147; Aldrov. ii. c. 41, p. 231; Jonst. De Pisc. lib. i, t. iii, c. 1, art. 23, p. 84, t. xx, f. 6; Willugh. p. 317, t. U. S. f. 1; Ray, p. 135. *Sparus*, No. 6, Artedi, Gen. p. 36.

Sparus boops, Linn. Syst. Nat. i, p. 469; Gmel. Linn. p. 1274; Brünn. Pisc. Mass. p. 44; Lacép. iv, pp. 97, 99; Bl. Schn. p. 273; Risso, Ich. Nice, p. 242; Martens, Reise nach Venedig, ii, p. 424.

Box vulgaris, Cuv. and Val. vi, p. 348, pl. clxi; Cuv. Règ. Anim. Ill. Poissons, pl. xxxvi, f. 1; Guichenot, Explor. Sc. Alger. Poissons, p. 54; Yarrell, Zool. 1843, p. 85, and Brit. Fishes, Second Supplement, 1860, p. 6, c. fig. and (Ed. 3) ii, p. 159; Günther, Catal. i. p. 418; Steind. Ich. Spanien u. Port. 1867, p. 49.

Boops Canariensis, Val. in Webb and Berth. Hist. Nat. Iles Canar. Poiss. p. 36, pl. x, f. 1.

Sparus boops, Swainson, Fishes, ii, p. 223.

Boops boops, White, Catal. Brit. Fish. p. 20.

Bogue, Couch, Fish. Brit. Isles, i, p. 225, pl. 1.

B. vi, D. $\frac{14}{14\text{-}15}$, P. 21, V. 1/5, A. $\frac{3}{15}$, C. 17, L. l. 75, L. tr. 6/13, Cœc. pyl. 5, Vert. 10-11/13.

Length of head $4\frac{3}{4}$, of caudal fin $5\frac{1}{4}$, height of body $4\frac{1}{4}$ to 5 in the total length. *Eye*—3 to $3\frac{1}{2}$ diameters in the length of the head, 2/3 to 1 diameter from the end of the snout, and the same distance apart. Interorbital space flattened and rather convex. The maxilla does not quite reach to below the front edge of the eye in adults, but does in the young. Preorbital rather narrow, and longer than deep. *Teeth*—the anterior row in both jaws flattened and notched at their cutting edge into a trefoil shape: fine ones on the vomer, palatines, and on the tongue. *Fins*—dorsal spines weak. Pectoral as long as the head. Last dorsal and anal ray thickened. Caudal deeply forked. *Scales*—cycloid, arranged in regular lines on the body: 3 or 4 rows across the cheeks, also present on the opercular pieces, but none along the preopercular limb. A few over the caudal fin. *Intestinal tract*—the stomach is small, with thin and transparent walls: its ascending portion is narrow at its commencement, but subsequently dilates into double its original width. There are five cœcal appendages at the pylorus, four on the lower side of the duodenum, and one on its upper surface. The intestines are much convoluted, while at the commencement of the rectum it suddenly dilates and gives off a sort of little cœcum, which has been likened to a true cœcal appendage, subsequent to which the intestine again contracts. *Colours*—yellowish-olive on the back, becoming silvery on the abdomen: three or four golden lines pass along the sides below the lateral-line. A brown spot in the axil of the pectoral fin.

Names.—*Boga*, French.

Habits.—It feeds on sea-weeds and occasionally devours small marine animals, but appears to subsist chiefly on a vegetable diet.

Means of capture.—In Provence and Nice peculiar kinds of nets, termed *bughiera*, are said to be employed for taking these fishes, while for good luck the boats are adorned with silver figures of the *bogue*.

Breeding.—It is stated to spawn twice a year near the shore.

As food.—It is good and digestible according to Rondel, but on the Atlantic coast of Spain, Cornide described them as disagreeable in taste, and only eaten by the poor: while on the coast of Provence it is especially esteemed when full of spawn, according to Valenciennes.

Habitat.—From the southern shores of the British isles as far south as Madeira and the Canaries, while an example, said to have been obtained from St. Vincent's, in the West Indies, is in the British Museum. It is also common throughout the Mediterranean.

The first example observed in this country was at Falmouth, in October, 1843, when one was taken in a ground seine along with some mullets: several examples have since been captured at the same place. June 26th, 1872, one was caught near Plymouth; and March 15th, 1873, a specimen, 12 inches long, was obtained in a herring-net at Helford Harbour.

It attains at least 16 inches in length, as seen in a specimen from Lisbon in the British Museum. For the example figured, life-size, I am indebted to Professor Peters, Director of the Zoological Museum at Berlin.*

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* **Mæna vulgaris,** *Cuvier and Valenciennes.*

Mendole, Couch, Fish. Brit. Isles, i, p. 206, pl. xlvi.

This fish may be an occasional wanderer into the British seas. I think, however, that the single example recorded, which was not kept, must from the description have been *Box vulgaris*, the only difference given, being that it was said to have pointed teeth.

Second group—Pagrina.

Cutting teeth in front of jaws: and molars along the sides.

Genus III.—Pagrus, *Cuvier.*

Chrysophrys, Cuvier: *Argyrops* and *Chrysoblephus*, Swainson: *Sparus*, Bleeker, 1877.

Branchiostegals six: pseudobranchiæ present. Jaws with an anterior row of conical or compressed canines, and laterally two, three or even four rows of rounded molars. A single dorsal fin with from 11 *to* 13, *sometimes elongated, spines, receivable into a groove at their base: anal with three. Scales of moderate size, extending on to the cheeks. Air-bladder usually simple, but sometimes notched or with short appendages. Pyloric appendages, when present, in small numbers.*

The Genus *Pagrus* Cuvier is divided from *Chrysophrys* Cuvier, owing to the first merely possessing 2 rows of rounded molars laterally, which in the last may be augmented to 3 or even 4. But even in *Pagrus vulgaris*, a rudimentary internal third row may be observed, and in species of *Chrysophrys*, a considerable latitude in the mode of dentition is perceptible. Thus in *Chrysophrys Cuvieri* * Day, the anterior teeth are conical, while the size of the molars is far less than seen in typical species of *Chrysophrys*. I have for these and other reasons adopted Steindachners views in considering the two as portions of the same genus.

Geographical distribution.—From the southern shores of the British Isles, Atlantic and Indian Oceans: Mediterranean and Red Sea to Australia.

1. Pagrus vulgaris, Plate XI.

Πάγρος, Aristot. viii, c. 13, 17.

Pagrus, Rondel. v. c. 15, p. 142; Artedi, Genera, p. 36. *Orphus*, Gesner, 1598, f. 27, c. fig.; Jonston, lib. i, t. iii, c. i, art. v, p. 68, t. xviii, f. 8. *Sparus*, No. 4, Artedi, Genera, p. 36; Duhamel, iv, c. 2, p. 29.

Sparus pagrus, Linn. Syst. Nat. i, p. 460; Brünn. Pisc. Mass. p. 94; Shaw, Zool. iv, p. 408; Risso, Ich. Nice, p. 241; De la Roche, Ann. Mus. xiii, p. 317; Martens, Reise nach Venedig. ii, p. 425.

Sparus argenteus, Bl. Schn. p. 271.

Aurata orphus, Risso, Eur. Mérid. iii, p. 356.

Pagrus pagrus, Risso, Eur. Mérid. iii, p. 360.

Pagrus vulgaris, Cuv. and Val. vi, p. 142, pl. cxlviii; Yarrell, Brit. Fish. (Ed. 1, 2 and 3 figure not description); Val. in Webb and Berthel. Hist. Nat. Isles Canar. Poiss. p. 32; Guichen. Explr. Sc. Algér. Poiss. p. 49; Günther, Catal. i, p. 466; Steindach. Ich. Span. u. Port. 1867, p. 53.

Pagrus orphus, Cuv. and Val. vi, p. 150, pl. cxlix; White, Catal. Brit. Fish. p. 17; Val. in Webb and Berth. Hist. Nat. Isles Canar. Poiss. p. 32; Günther, Catal. i. p. 467; Yarrell, Brit. Fishes (Ed. 3) ii, p. 142, c. fig. and vignette of teeth.

Couch's sea-Bream, Couch, Zool. 1843, i, p. 81, c. fig. and Fish. Brit. Isles, i, p. 231, pl. lii.

Pagellus Rondeletii, Couch, Zool. 1846, p. 1406; Yarrell's, Brit. Fish. 2nd Supp. p. 4.

B. vi, D. $\frac{12}{10}$, P. 15, V. 1/5, A. $\frac{3}{8}$, C. 17, L. l. 53—58, L. tr. 7/17, Cœc. pyl. 5.

Length of head $3\frac{3}{4}$ to $4\frac{1}{4}$, of caudal fin $4\frac{3}{4}$ to 5, height of body $2\frac{3}{4}$ to $3\frac{1}{2}$ in the total length. *Eye*—diameter $3\frac{1}{4}$ to 4 in the length of the head, 1 to 2 diameters from the end of the snout, and 2 apart. Interorbital space convex. Upper profile from the dorsal fin to the eye parabolic, from thence it abruptly descends to the mouth, which descent is usually most vertical in old examples. The maxilla

* Day, Fishes of India, i, p. 141, pl. xxxiv, f. 3.

reaches to beneath the middle of the eye: lower jaw slightly the longer. Preopercle twice as high as broad. Preorbital large, being as high or higher than broad, its depth exceeding the width of the eye. *Teeth*—an outer conical row in the upper jaw, the 4 front rows of which are enlarged: while posteriorly in both jaws exist 2 or 3 rows of rounded molars. Two large canines anteriorly on either side of the mandible. *Fins*—dorsal spines of moderate strength, increasing in length to the third, from whence they equal the height of the rays and about 1/3 of that of the body. Pectoral pointed, rather longer than the head, and reaching to above the anal spines. Ventral does not extend so far as the vent. Second anal spine stronger, but not quite so long as the third. Caudal forked. *Scales*—extend forwards to above the eyes: 6 rows across the cheeks and 8 across the opercles, those on the head being much smaller than those on the body. *Colours*—the front and top of the head brownish-red: back and fins, except the anal, as if formed by a mixture of lake and vermillion: occasionally the back has broad reddish bands descending to the abdomen: anal pale yellow: sides pale red: under surface dull white: iris yellow. The young are plain silvery, with reddish bands. In some examples a blue band passes from one eye to the other, but which is said to be absent in others. Rondel observed that during winter it becomes of a bluish tint, which remark, however, still needs confirmation.

Varieties.—This fish has occasioned considerable trouble to Ichthyologists from the time of Bloch until the present, as owing to errors of identification its occurrence on our southern shores is every now and then being recorded. Bloch's figure of *Sparus pagrus*, with its black shoulder spot, is perhaps *Pagellus centrodontus*, as the illustration of its teeth does not coincide what exists in *Pagrus*, the difference however between the head of Bloch's fish and what obtains in *Pagellus centrodontus* will be referred to at page 37. While the figure of *Pagrus* in Aldrovandus also represents the *Pagellus centrodontus*.

Risso seems to have described this fish in his *Sparus pagrus*, but he considered it to be identical with Bloch's figure. Subsequently in his larger work he named another fish *Aurata orphus*, retaining his *Pagrus pagrus*, identical as he still considered it, with Bloch's species.

Valenciennes held that Bloch's figure represented *Pagellus centrodontus* and Risso's description *Pagrus vulgaris*, but he considered that *Aurata orphus* Risso with a blue interorbital band and a more abrupt profile of the snout was a distinct species: which, however, Steindachner has, it appears to me, with much justice dissented from.

Yarrell in his Fishes of the British Isles gave a figure of *Pagrus vulgaris* taken from Cuvier and Valenciennes' grand work: this he identified with the *Braize* or *Becker* of the south coast of England, taking his description from a British example, to this he added a vignette of the dentition as he found it, but the dentition and his specimens which are still preserved in the national collection belong to *Pagellus erythrinus*. Couch likewise terms the *Braize* or *Becker*, *Pagrus vulgaris*, and it is more difficult to understand to what fish he refers (vol. i, p. 228, pl. li), the fin rays are thus briefly described "dorsal nine, anal three." He states it to be "common on the south and west of England, but it does not appear to be of frequent occurrence in the north of England or Scotland. . . Its habits are migratory, and its visits are confined to the summer and autumn, leaving us, on the approach of colder weather, in the beginning of the winter. It is a solitary fish." As Couch appears to have obtained only a single example of *Pagrus*, and which he considered to be an unknown species, or Couch's sea bream, we are justified in believing that he made some error in his diagnosis of the species, having in reality described a *Pagellus* as *Pagrus vulgaris*, and published a figure of an unknown fish as a representation, so far as I have been able to ascertain.

Habits.—Risso observes that it approaches the shore in summer. While Valenciennes, who examined the intestines of one (*P. orphus*), remarks that the stomach and abdominal cavity were filled with the remains of small shell fish having horny opercles, consuming such as have a less hard shell than *Turbo* or *Trochus*.

Breeding.—Risso found that his *Aurata orphus* deposited its eggs on the shingly shore in summer.

Habitat.—From the Canary Islands in the north Atlantic as far as the British coast, where a straggler has been obtained: through the Mediterranean, including the Gulf of Genoa.

The single undoubted British example hitherto recorded was one weighing 6 lb. 20 inches in length, and captured by bait, November 8th, 1842, at a rocky ledge termed the Edges, about two miles south of Polperro in Cornwall, and was at once taken to Mr. Couch. Its form is of the variety *orphus*, but its colours were those of the *Pagrus vulgaris*.

This species is said to attain to 11 lb. or more.

The figure is from Couch's stuffed example: the teeth after Steindachner's figure, l.c., and taken from another specimen, as Yarrell has figured this apparatus from Couch's specimen in which they are injured or worn from age.

2 Pagrus auratus, Plate XII.

Χρύσοφρυς, Arist. i, c. 5, ii, c. 17, iv, c. 10, v, c. 10, vi, c. 17, viii, c. 2, 13, 15, 19; Athen. vii, p. 328; Ælian, xiii, c. 28, xvi, c. 12; Oppian, i. p. 7.

Aurata, Columella, viii, c. 16; Plin. ix, c. 16; Belon. pp. 192, 193; Rondel. v, c. 2, p. 115, c. fig.; Salvian. fol. 174*b*, 175; Gesner, pp. 110, 128; Jonston, De Pisc. lib. i, t. 3, c. i, art, 8, p. 70, t. xix, f. 2; Willughby, p. 307, t. V, f. 5; Ray, p. 131. *Aurata vulgaris*, Aldrov. ii, c. 15, p. 171. *Sparus*, No. 1, Artedi Genera, 25, Syn. 63; Gronov. Mus. Ich. p. 38, No. 90; Duhamel, Pêches, ii, Sect. 4, pl. xi, f. i. *Mochar*, Osbeck, Nov. Act. Nat. Cur. iv, p. 100. *Lunulated gilt head*, Pennant, Brit. Zool. (Ed. 1) iii, p. 240, not pl. xlii (Ed. 2) iii, p. 327, not pl. xlvi.

Sparus aurata, Linn. Mus. Ad. Fr. 2, p. 62, and Syst. Nat. i, p. 467; Hasselquist, Iter. Palest. p. 337; Brünn. Pisc. Mass. p. 36; Gmel. Linn. p. 1270; Bloch, t. 266; Bl. Schn.p. 270; Lacépède, iv, p. 57; Risso, Ich. Nice, p. 234; Martens, Reise nach Venedig. ii, p. 424; Flem. Brit. Anim. p. 211; Johnston, Fish. Berwick. Mag. Nat. Hist. vi, 1833, p. 15; Jenyns, Man. Brit. Vert. p. 353.

Sparus scriptus, Bl. Schn. p. 279.

Chrysophrys aurata, Cuv. and Val. vi, p. 85, pl. cxlv; Guichen. Expl. Sc. Alger. Poiss. p. 48; Yarrell, Brit. Fish. (Ed. 1), i, p. 97, c. fig. (Ed. 2), i, p. 111, (Ed. 3), ii, p. 135; Swainson, Fishes, ii, p. 221; White, Catal. Brit. Fish. p. 17; Günther, Catal. i, p. 484; Steind. Sitz. Ak. Wiss. Wien, 1867, lvi, p. 658.

Chrysophrys crassirostris, Cuv. and Val. vi, p. 98, pl. cxlvi; Günther, Catal. i, p. 484.

The gilt head, Couch, Fish. Brit. Isles, i, p. 243, pl. lvii.

Pagrus auratus, Steind. Ich. Spanien u. Port. 1867, p. 56.

B. vi, D. $\frac{11}{13}$, P. 16, V. 1/5, A. $\frac{3}{11-12}$, C. 17, L. l. 75-86, L. tr. 8-9/19, Cœc. pyl. 3-4, Vert. 10/14.

Length of head 4 to $4\frac{1}{4}$, of caudal fin $5\frac{1}{4}$ to $5\frac{1}{2}$, height of body $3\frac{1}{3}$ to $3\frac{1}{2}$ in the total length. *Eye*—$3\frac{1}{2}$ to $5\frac{1}{2}$ diameters in the length of the head, $1\frac{1}{4}$ to $2\frac{1}{2}$ diameters from the end of the snout and also apart. Interorbital space rather convex in adults. Preorbital 2/3 as high as long. The lower jaw not quite so long anteriorly as the upper: the maxilla reaches to beneath the front edge or even (in the young) the first third of the eye. *Teeth*—an anterior row of about 6 conical teeth in either jaws: laterally rounded molars increasing in size posteriorly and forming 2 rows in the lower and 3 in the upper jaw, the posterior and internal ones of which are the largest, increasing in size with age. None on the vomer, palatines, or tongue. *Fins*—dorsal spines of moderate strength, the 3rd and 4th being somewhat the longest. Pectoral longer than the head. The second and third anal spines of nearly the same length and strength. Caudal forked. *Scales*—with slightly irregular edges and straight parallel lines, 7 rows cross the cheek between the eye and the angle of the

preopercle. *Intestines*—in an example $5\frac{1}{2}$ inches long the distance from the pylorus to the vent was $3\frac{1}{2}$ inches: there were only 3 cœcal appendages. *Colours*—silvery, becoming lighter on the sides and almost white on the abdomen: traces of longitudinal lines have been observed along the body and a dark spot at the base of the pectoral fin. A crescentic golden band, the concavity of which is directed backwards, passes between the eyes: top of the head iridescent green. A dark spot at the upper end of the opercle.

Although Pennant has the *lunulated gilt-head* in his work, such is composed of two species, the figure distinctly representing *Pagellus centrodontus*, whereas the description is partially that of *Pagrus auratus*, which error has been repeated in several more recent works.

Names and their origin.—*Gilt-head* and *gilt-poll* from its predominant colours, and *lunulated gilt-head* from the form of its interorbital golden band. It was consecrated to Venus by the Romans under the name of *Aurata sargon* (Halliwell). In Rome during the time of Belonius these fishes had different designations according to their lengths; those a palm long were named *sanguène*, if a cubit in length *daurades*, while the intermediate sizes were termed *méiane*. Very large ones were known as *subredaurades*. *Thunor-bodu*, Anglo-Saxon; Mr. Skeat considers the term to apply to this fish, it means "thunder-boder," or the precursor of thunder, which would seem to be an example of folklore. *Peneuryn* or *Eurben*, Welsh. *La Daurade vulgaire*, French.

Habits.—These fish appear to frequent the sea on bold and rocky coasts, where they feed on crabs and shell fish, which their powerful molar teeth would be well adapted to crush and grind up. Duhamel states that they stir up the sand with their tails to obtain small shell-fish. They assemble in shoals at the mouths of rivers, but are said to be very sensible to impressions of cold when they retire to deeper waters: and Duhamel observed that fishes of this genus died in numbers during the severe winter of 1766.

Means of capture.—Nets and lines. Off the coast of Languedoc, the hooks are baited with pieces of mussel or other shell fish, as *Venus decussata*, or if these are unobtainable with shrimps or pieces of tunny.

Breeding.—Said to spawn in summer.

As food.—Coarse, but much valued by the Romans, who kept them in vivaria on an oyster diet, which improved their appearance and heightened their flavour. In some places on the continent of Europe they are still esteemed, although considered to be rather dry: those which have entered brackish waters being preferred.

Habitat.—From the British coast as far south in the Atlantic as the Cape of Good Hope (? variety *P. globiceps* C. and V.). Also through the Mediterranean to the Adriatic.

This fish is a wanderer to the British shores, and has been recorded from Devonshire. Fleming had "seen it once caught in the estuary of the Tay in August," but perhaps owing to his considering *Sparus auratus* (Pennant and Donovan) to be this species but which really is *Pagellus centrodontus*, he appears to have added to his otherwise correct description, "a black spot at the origin of the lateral-line." Edward (Life, p. 419) records two from Banffshire, one brought on shore at Portsoy in 1839: the other captured off Buckie in 1841.

That the gilt-head is very rare on our shores is evident. It was first alluded to by Colonel Montagu, who in 1802 examined two examples from Torcross, while another 15 inches long is mentioned by Yarrell as having been obtained in the London fish-market, and one 8 inches long from the mouth of the Tweed. July 23rd, 1846, Mr. Cocks purchased one in the Falmouth market, and a few days subsequently a second. March 1st, 1870, Mr. Cornish (Zoologist, 1870, p. 2108) recorded one $18\frac{1}{4}$ inches in length from Penzance, where it had been taken in a grey mullet net, in shallow water off a sandy beach.

Ireland.—Considerable doubts exist respecting the visits of this fish to

the Irish coast. Rutty (Nat. Hist. Dublin, i, 368) observes "*Aurata Salviani.* The gilt-head or gilt-poll here called the *Sea Bream*, which is very frequent about the rocks of *Dunleary.*" The fish here mentioned was probably a *Pagellus.* Thompson (Nat. Hist. Ireland, iv, p. 91) considers that Templeton's *Sparus auratus* referred to (Ann. Nat. Hist. (2) i, p. 409) as "often taken during the summer and autumnal months, principally when currents sweep along the rocky shore," must be *Pagellus centrodontus*, doubting the existence of this fish in Ireland.

For the example figured (life-size) I am indebted to Professor Hubrecht of Leyden. The fish grows in British waters to at least $18\frac{1}{4}$ inches in length, but becomes larger in the Mediterranean.

Genus XI—Pagellus, *Cuvier and Valenciennes.*

Branchiostegals six: pseudobranchiæ present. Opercles unarmed. The teeth in the anterior part of either jaw cardlike without canines, the outer series being somewhat enlarged; posteriorly two or more rows of rounded molars in either jaw. The spines of the dorsal fin (11 *to* 13) *are receivable into a basal groove: three anal spines. Scales of moderate size, some present on the cheeks. Air-bladder simple. Pyloric appendages few.*

The molar teeth in the genus *Pagellus* are much smaller than what are seen in those which belong to *Pagrus*, C. V., including *Chrysophrys*, C. V.

Geographical distribution.—From the seas of Scandinavia, along the British shores to the Canaries, the Cape of Good Hope, as well as the Atlantic coast of Tropical America. Also throughout the Mediterranean and Black Sea.

These fishes are commonly known as *sea-breams.* One form termed *silver eyes* is said to pursue small fishes in Cardigan Bay, and Mr. Dunn, of Mevagissey, informs me that sea-breams frequently come in shoals at night-time to feed on the pilchards entangled in the fishermen's nets, and which they often rapidly clear: this seems to be most common on moonlight nights, as at other times they are ground feeders.

In Cornwall when two-thirds grown they are known as *grobman*, if younger as *chads.* Mr. Dunn has observed at Mevagissey that "sea-breams" leave the coast in November when they have no spawn, returning in April, whereas at Land's End they arrive in March: on their arrival they seem to have concluded spawning. The *chads* appear the first week in July.

In considering the number of species recorded from the seas of Great Britain, I observe that Yarrell (Ed. 3) mentions three, irrespective of his braize or becker, which is in reality a *Pagellus.* Couch also has the becker, three *Pagelli*, and one variety. The number of species from these shores which I have obtained or examined and figured is five, one being that of a skin existing in the British Museum from Parnell's Frith of Forth collection as *P. acarne*, other examples of which from Yarrell's collection have also been seen.

Couch mentions a tale of the common sea-bream showing how superstitious the fishermen of Cornwall were at the commencement of this century. An old woman whose appearance and language were similar to what those of witches were supposed to be, came to a seine boat and requested the gift of a few pilchards, but received a curt refusal. With expressions of anger and wishes for their ill-luck she left the beach. When the fishermen returned to their nets for the purpose of obtaining the remainder of their capture they found only chads instead of pilchards and likewise a drowned toad, the last being considered as unmistakably a proof of the witch's power, which was further shown by transforming their pilchards into worthless chads. One of the fishermen took the toad to the supposed witch's house into which he flung it, uttering exclamations the reverse of friendly to the agent of the evil one. The war with France was then going on, and among the prisoners captured was this very fisherman who in attempting to escape fell before the bullets of his guard, he being the only one who was shot.

The following is a synopsis of the British *sea-breams* as at present recognized:—

1. *Pagellus centrodontus*, D. $\frac{12}{12}$, A. $\frac{3}{12}$, L. l. 75. Length of head $3\frac{3}{4}$ to 4 in the total. Normally 2 rows of rounded molars in both jaws or 3 in the upper. Last 2 dorsal and anal rays not scaled. A black shoulder spot at commencement of lateral-line. 7 rows of scales across the cheeks.

2. *Pagellus bogaraveo*, D. $\frac{12\text{-}13}{12\text{-}11}$, A. $\frac{3}{11\text{-}12}$, L. l. 71. Length of head $3\frac{2}{3}$ to 4 in the total. 2 or 3 rows of rounded molars in upper, and 2 in lower jaw. Last 2 dorsal and anal rays not scaled. A dark axillary spot, 6 or 7 rows of scales across the cheeks.

3. *Pagellus Owenii*, D. $\frac{12}{11\text{-}12}$, A. $\frac{3}{10}$, L. l. 68-70. Length of head $3\frac{1}{3}$ to $3\frac{2}{3}$ in the total. 3 or 4 rows of rounded molars in the upper, and 2 or 3 in the lower

jaw. Last two dorsal and anal rays united by being invested in a common scaly sheath, 5 rows of scales across the cheeks.

4. *Pagellus acarne*, D. $\frac{12}{11\text{-}12}$, A. $\frac{3}{10}$, L. l. 70-72. Length of head $3\frac{1}{2}$ to $3\frac{2}{3}$ in the total. Two rows of rounded molars in both jaws. Last 2 dorsal and anal rays united by being invested in a common membrane. Five rows of scales across the cheeks.

5. *Pagellus erythrinus*, D. $\frac{12}{10}$, A. $\frac{3}{8\text{-}9}$, L. l. 56-60. Length of head $3\frac{3}{4}$ to 4 in the total. Two rows of rounded molars in either jaw. Last 2 dorsal and anal rays not scaled. Six rows of scales across the cheeks.

1. Pagellus centrodontus, Plate XIII.

Orphus, Rondel. v. c. 25, p. 157, c. fig; Aldrov. ii, c. 2, p. 158. *Pagrus*, Aldrov. p. 151; Willughby, p. 312, t. V. i, f. 5. *Lunulated gilt-head*, Pennant, Brit. Zool. (Ed. 1), iii, p. 240, pl. xlii, not descr. (Ed. 2), iii, p. 327, pl. xlvi, not description.

Sparus orphus, Lacép. iv, p. 146.

Sparus pagrus, Bloch, t. cclxvii; Lacép, iii, p. 87; Bl. Schn. p. 271; Turton, Brit. Fauna, p. 98.

Sparus aurata, Donovan, Brit. Fish. iv, pl. lxxxix; Turton, l. c. p. 97; Duhamel, Pêches, ii, Sect. 4, c. 2, p. 30 (not Lin.).

Sparus centrodontus, De la Roche, Ann. Mus. xiii, p. 345, pl. xxiii, f. 2; Jenyns, Manual, p. 356; Johnston, Berwick. Nat. Field Club, 1838, i, p. 171.

Sparus Massiliensis, Risso, Ich. Nice, p. 247.

Aurata Massiliensis, Risso, Eur. Mérid. iii, p. 357.

Pagrus vulgaris, Flem. Brit. Anim. p. 211.

Pagellus centrodontus, Cuv. and Val. vi, p. 180; Parnell, Fish. Frith of Forth, p. 46, pl. xxvii; Yarrell, Brit. Fish. (Ed. 1), i, p. 107, c. fig. (Ed. 2) i, p. 123 (Ed. 3), ii, p. 149: Val. in Webb and Berth. Hist. Nat. Iles. Canar. Poiss. p. 34, pl. vii, fig. 3; Guichen. Explor. Sc. Algér. Poiss. p. 50; White, Catal. Brit. Fish. p. 18; Thompson, Nat. Hist. Ireland, iv, p. 90; Schlegel, De Dieren v. Ned. 1862, p. 23, pl. ii, f. 4; Günther, Cat. i, p. 476; Steind. Ich. Spain and Port. 1867, p. 61; Collett, Norges Fiske, p. 18; McIntosh, Fish. St. Andrews, p. 172.

Pagellus curtus, Couch, Zool. 1843, p. 393, c. fig. and *short sea-bream*, Fish. Brit. Isles, i, p. 241, pl. lvi (*deformed*).

Common sea-bream, Couch, Fish. Brit. Isles, i, p. 237, pl. lv.

B. vi, D. $\frac{12}{12}$, P. 17, V. 1/5, A. $\frac{3}{12}$, C. 19, L. l. 75, L. tr. 7/16, Cœc. pyl. 4, Vert. 10/14.

Length of head $3\frac{3}{4}$ to 4, of caudal fin 5 to $5\frac{1}{2}$, height of body $3\frac{1}{4}$ to $3\frac{1}{2}$ in the total length. *Eye*—$3\frac{1}{3}$ to $3\frac{1}{2}$ diameters in the length of the head, 1 diameter from the end of the snout, and also apart. Interorbital space flattened. Preorbital wider anteriorly than it is posteriorly, its greatest depth being scarcely equal to half its length; it is unnotched over the posterior end of the maxilla. Opercle about twice as high as wide. Jaws of equal length in front; the maxilla reaches to beneath the front edge or even anterior third of the eye. Posterior nostril the largest and obliquely oval. *Teeth*—3 or 4 irregularly placed rows of rounded teeth of different sizes laterally and posteriorly in either jaw, none on vomer, palatine bones or tongue. *Fins*—dorsal spines rather strong, the 4th and 5th the longest, from whence they decrease in length; rays shorter than the spines, the last two somewhat thickened but not scaled, nor adherent together: Donovan observes that in his example there were 13 spines and 11 soft rays in the dorsal fin, the same number being shown by the artist. Pectoral as long as the head. Ventral not extending so far as the vent. Third anal spine somewhat longer than the second. Caudal deeply forked. *Scales*—finely ctenoid, 7 rows between the eye and the angle of the preopercle. *Colours*—orange-scarlet becoming lighter beneath. A large black spot on the shoulder intersected by the lateral-line, but which is absent in the young: Couch believed that it does not appear until they are twelve months old.

Varieties.—Couch on September 2nd, 1843, obtained one of a shortened form, 13 inches long and 5½ high, probably due to spinal disease with which these fish are not infrequently affected. Yarrell also figures an adult example in which the premaxillary bones were absent. Although *Sparus pagrus*, Bloch, is probably intended for this fish, the eye is too small and the preorbital too deep.

Names.—Common sea bream, sharp-toothed sea bream. Red gilt head: Chad (if young, Cornwall) : *Boger* (Cornw. half grown).

In Ireland *Murranroe and Barwin* (county of Antrim) : *Gunner* out he north-west coast : *carf, carp,* and *sea bream* on the north-east : and *Brazier* on the north. *Brôm y Môr,* Welsh. *De zee-brasem,* Dutch. *Le Rousseau,* French.

Habits.—Prefers the vicinity of rocks and sea weeds, is very sensible to cold, consequently in severe winters most of them retire to the deep sea beyond the reach of fishermen, but return as the weather becomes warmer. Sometimes they congregate in large numbers, frequently about the end of summer, when they have been observed to rise to the surface and may be mistaken for pilchards. Couch records how on one occasion 20,000 and on another 60,000 were caught in a season at one time. Those of various sizes appear to keep together. They feed upon small fish, crustacea, and sea-weed. Mr. Dunn observes that in 1874 a vessel was wrecked in Cornwall laden with wheat, the whole of which was lost in the sea. On fishing soon after he found the stomachs of these fish full of wheat. They were plump and in good condition.

Means of capture.—Frequently taken with the haddock in Ireland, the bait being the lug-worm, shell-fish (mussels, &c.), and herring-fry, or a slice of mackerel.

Breeding.—Towards the end of the year or in the winter months, as in January the young are about 1 inch in length, but they do not come towards land until early in the summer, when, and also through autumn, they abound.

As food.—Not esteemed in England as they soon become stale and tainted: but large numbers are disposed of throughout the midland counties : they salt badly. Hardly esteemed in Belfast. Highly prized in the county of Down.

Yarrell suggested the following mode of cooking these fish. When thoroughly cleaned they should be wiped dry, but none of the scales removed. Then broiled, frequently turning, and if the skin cracks flouring them to keep the outer case entire. On the table the skin and scales turn off without difficulty, and the muscle beneath, saturated with its own juices, will be found of good flavour.

Habitat.—From the coasts of Scandinavia through the North Sea and North Atlantic Ocean to the Mediterranean.

In Great Britain this fish has a range from one extremity to the other, abounding especially along the southern and western coasts, but decreasing in numbers as we go north. In the Frith of Forth, Parnell only recorded (1838) two specimens, and Smith (Ann. Nat. Hist. 1852, ix, p. 154) remarks on a single example considering it very uncommon. But McIntosh observes that they are not rare in St. Andrew's Bay, and Edward, that numbers appear annually off the coast of Banffshire, more abundant in some seasons than in others, while in the Moray Frith, Harris (Zool. ix, 1851) says "they are common and have vastly increased during the last 3 years;" while in 1852 their numbers again augmented when, according to Gordon, they were termed the *siller-fish* (Zool. 1852, p. 3458). In the Orkneys one specimen was obtained by Dr. Duguid in Scalpa near Kirkwall (Baikie, Zool. 1853, xi, p. 3952).

In Ireland, observes Thompson, they are common all round the coast.

The example figured was received from Mr. Dunn of Mevagissey, it is 15 inches in length. They are taken up to 3 or 5 lb. weight.

2. Pagellus bogaraveo, Plate XIV.

Sparus bogaraveo, Brünn. Pisc. Mass. p. 49 ; Lacép. iv, pp. 111, 112 ; Risso, Ich. Nice, p. 249.

Pagrus bogaraveo, Risso, Eur. Merid. p. 359 ; Duhamel, Pêches, Sect. 4, pl. i, f. 1.

Pagellus bogaraveo, Cuv. and Val. vi, p. 196 ; Günther, Catal. i, p. 480.

Spanish Bream, Couch, Fish. Brit. Isles, i, p. 235, pl. liii.

B. vi, D. $\frac{12-13}{12-11}$, P. 17, V. 1/5, A. $\frac{3}{11\ 12}$, C. 17, L. l. 71, L. tr. 7/15. Cœc. pyl. 5, Vert. 22.

Length of head $3\frac{2}{3}$ to 4, of caudal fin $5\frac{1}{2}$, height of body $3\frac{1}{3}$ to $3\frac{1}{2}$ in the total length. *Eye*—3 to $3\frac{1}{4}$ diameters in the length of the head, $\frac{3}{4}$ of a diameter from the end of the snout, and about 1 diameter apart. Preorbital much narrower posteriorly than it is anteriorly, its greatest height being rather less than half its length: it is without any notch. Snout obtuse. Posterior nostril oval and placed obliquely. Jaws even in front: the maxilla extends posteriorly to beneath the front fourth of the eye. *Teeth*—fine, the anterior ones in the outer row in the upper jaw rather larger than the others: posteriorly 2 or 3 rows of rounded molars in the upper and 2 in the lower jaw. *Fins*—dorsal spines of moderate strength, increasing in length to the 4th or 5th, then decreasing to the last: one example had 13 spines and 11 rays. Pectoral reaches to opposite the first third of the anal fin. Caudal forked. *Scales*—6 or 7 rows between the eye and the angle of the preopercle. *Cœcal appendages* five. *Colours*—pinkish, with a dark base to the pectoral fin, and a dark spot in the axilla. During life numerous small blue spots are seen over the body, most distinct above and below the lateral-line along which about 52 were present in the example which is figured.

Name.—Couch first employs the name *Spanish bream* in Mag. Nat. Hist. v, 1832, for *Pagellus erythrinus*, subsequently to this fish.

Habitat.—British coast to the Mediterranean. This species, Couch observes, is the best known to Cornish fishermen of all the species of sea breams that wander to our shores only on unusual occasions; and with them it bears the name of *Spanish bream*, and only single examples are met with, which are usually caught with a baited hook, in the summer and autumn.

The example figured I received from Mr. Dunn of Mevagissey, where it does not appear to be rare.

Couch says this fish attains to scarcely more than two-thirds the size of the *P. centrodontus*.

3. **Pagellus Owenii,** Plate XV.

? Red gilt-head, Pennant, Brit. Zool. (Ed. 1) iii, p. 242, (Ed. 2) iii, p. 329.

Pagellus acarne, Parnell, Fish. Frith of Forth, p. 24, pl. xxvii, and Mem. Wern. Society, vii, p. 204, pl. xxvii (not C. V.); Yarrell Brit. Fish. (Ed. 2) i, p. 122* (Ed. 3) ii, p. 147; White, Catal. Brit. Fish. p. 19.

Pagellus erythrinus, Yarrell (Ed. 1) i, p. 104, desc. and vignettes, exclude figure: (Ed. 2) i, p. 120, (Ed. 3) ii, p. 144 (not fig. or synon.)

Pagellus Owenii, Günther, Catal. i, p. 478.

B. vi, D. $\frac{12}{11-12}$, P. 17, V. 1/5, A. $\frac{3}{10}$, C. 21, L. l. 68-70, L. tr. 6/13.

Length of head $3\frac{1}{3}$ to $3\frac{2}{3}$, of caudal fin 6, height of body $3\frac{1}{4}$ in the total length. *Eye*—diameter $4\frac{1}{2}$ in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and about the same apart. Interorbital space convex. The anterior profile from the front edge of the dorsal fin to the snout forms a steep and almost semi-circular curve. Preorbital high, its highest portion equalling the diameter of the orbit, it is one-half longer than wide, being narrowest posteriorly, while its lower edge is not notched. Opercle rather more than twice as high as wide. Jaws of equal length in front: posteriorly the maxilla reaches nearly or quite to beneath the front edge of the eye. *Teeth*—anteriorly villiform with the outer row somewhat enlarged: the lateral rounded teeth are sometimes irregular, more especially in the upper jaw, where there are posteriorly 3 or even 4 rows, and 2 or 3 in the mandibles. *Fins*—dorsal spines of moderate strength increasing in length to the fourth, the height of which is about $2\frac{2}{3}$ in the length of the head; they decrease from the 5th: rays of about equal height to that of the last spine, the last two being invested together in a scaly sheath. Pectoral 2/3 as long as the head. Ventral 3/4 as long as the pectoral. Anal with the third spine the longest, and its last 2 rays similar to those of the soft dorsal. Caudal deeply forked. *Scales*—5 rows between the eye and the angle of the preopercle. *Colours*—back carmine,

becoming of a rose-red on the sides and nearly silvery-white beneath. Fins rose-colour, paler than the body. Parnell states it to have a dark violet spot at the base of the upper part of the pectoral fin, which is not visible in his specimen from which I took my figure. Yarrell observes that this mark is most conspicuous in the larger and older specimens.

Yarrell appears to have rather confused these species, doubtless from the difficulty in those days of obtaining examples for comparison; and though he figures *Pagellus erythrinus*, from Cuv. and Val.'s work, his description of the species was drawn up from British specimens subsequently received, and they pertained to this form as seen in his vignette of the teething, where the molars in the upper jaw are given in 3 regular rows, whereas when 3 rows exist in *P. erythrinus* they are irregular; also the the last two dorsal and anal rays being enveloped in a scaled covering certainly cannot refer to *P. erythrinus*. He subsequently figured and again described this fish as *P. acarne*. Four of his specimens are in the British Museum. Couch likewise give *P. acarne*, which, however, refers to *P. bogaraveo*, and he does not describe the *P. Owenii* at all.

This appears to be the fish described by Pennant, who omits all allusion to it possessing a black shoulder spot, as seen in *Pagellus centrodontus*, and expressly notices the existence of a ferruginous spot at the base of the pectoral fin. He also states that "what is peculiar to his species is that the skin at the end of the dorsal and anal fins is gathered up and hides the last rays," which appearance does not exist in *P. centrodontus*, with which Pennant's fish has been classed, but does in the rarer British forms of *P. Owenii* and *P. acarne*. Couch's *Spanish bream* would appear to be *P. bogaraveo* and not *P. acarne*, with which he has identified it, if we are to judge by his figure of the length and size of the head and the form of the preorbital bone.

In Cuv. and Val. a *Pagellus breviceps*, vi, p. 199, is briefly described from the Mediterranean, with an obtuse snout and the profile of the back more rounded than in the other forms: it may be this species.

Names.—Axillary bream.

Habits.—This fish does not appear to have met with much attention, having probably been mixed up with other better known forms of *Pagellus*: the only examples I have seen have been those in the National Collection.

Parnell observes that his description is taken from a specimen captured in the Frith of Forth in a salmon-net near Musselburgh in the early part of July. A second example was taken a few days subsequently.

Habitat.—As far as has been recorded this species has merely been captured off the British coast, in the Frith of Forth, Devonshire, and Cornwall. The example figured was a stuffed specimen, $13\frac{1}{2}$ inches in length, from Dr. Parnell's collection. This fish attains at least 14 inches in length.

4. Pagellus acarne, Plate XVI.

Acarnane, Rondel. v, c. 20, p. 151, c. fig.; Duhamel, Pêches, ii, Sect. iv, c. 2, p. 32.

Sparus berda, Risso, Ich. Nice, p. 252.

Pagrus acarne, Risso, Eur. Merid. iii, p. 361.

Pagellus acarne, Cuv. and Val. vi, p. 191; Cuv. Règne Anim. Ill. Poiss. pl. xxxv, f. i.; Guichen. Ex. Sc. Algér. Poiss. p. 51; Günther, Catal. i, p. 480; Steind. Ich. Spanien und Port. 1867, p. 60.

B. vi, D. $\frac{12}{11-12}$, P. 17, V. 1/5, A. $\frac{3}{10}$, C. 17, L. l. 70-72, L. tr. 5/13, Vert. 22.

Length of head $3\frac{1}{2}$ to $3\frac{2}{3}$, of caudal fin $5\frac{2}{3}$, height of body $3\frac{2}{3}$ in the total length. *Eye*—4 diameters in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout and nearly 1 apart. Preorbital narrowest posteriorly, destitute of any notch, while its greatest height equals $1\frac{1}{2}$ in its length. Opercle rather more than twice as high as wide. Jaws of equal length anteriorly, the maxilla reaches posteriorly to nearly beneath the front edge of the eye. Teeth anteriorly villiform, with the outer row somewhat enlarged, the lateral rounded teeth form two rows in either

jaw. *Fins*—dorsal spines rather strong, the third somewhat the longest: rays not so high as the highest spines, the last two enveloped in a common scaled membrane. Pectoral reaches to above the third anal spine. Third anal spine the longest: the last two rays of the fin similar to those of the soft dorsal. Caudal forked. *Scales*—5 rows between the eye and the angle of the preopercle. *Colours*—red with golden reflections; a dark spot in the axilla.

Habits.—This is likewise one of the forms which visit Britain, of which but ittle is known.

Habitat.—Southern coasts of great Britain to the Canary Islands and also the Mediterranean.

The British Museum possesses a small specimen in a good state of preservation, from Leach's Collection. It was obtained according to the label from Headslow, Cornwall. The example figured is $13\frac{1}{2}$ inches in length and in the British Museum, it was brought from Lanzarote by the Rev. R. T. Lowe.

5. Pagellus erythrinus, Plate XVII.

Erythrinus, Belon. p. 185; Rondel. v, c. 16, p. 144, c. fig; Salv. f. 239; Aldrov. ii, c. 9, p. 154; Gesner, p. 365, and ed. 1598, f. 25, c. fig; Jonston, lib. i, t. iii, c. i, art. 4, p. 67, t. xviii, f. 6; Willugh. c. 10, p. 311, t. V. f. 6; Ray p. 132. *Sparus*, No. 3, Artedi, Genera. 36 Syn. 59. *Cynœdus*, Gronov. Zooph. p. 61, No. 215.

Sparus erythrinus Linn. Syst. i, p. 469; Gmel. Linn. p. 1272; Bloch, pl. cclxxiv; Bl. Schn. p. 275; Shaw, Nat. Misc. xx, pl. 834; Risso, Ich. Nice, p. 240; Martens, Reise nach Venedig. ii, p. 425; Duhamel, Pêches, iv, c. 2. p. 29; Couch, Mag. Nat. Hist. v. 1832, p. 17, f. 3; Jenyns, Brit. Vert. p. 355.

Sparus pagellus, Lacép. iii, p. 86.

Pagrus erythrinus, Risso, Eur. Mérid. iii, p. 361.

Pagellus erythrinus, Cuv. and Val. vi, p. 170, pl. cl; Yarrell, Brit. Fish. (Ed. 1) i, p. 104, c. fig. exc. description and vignette of teeth, (Ed. 2) i, p. 120, (Ed. 3) ii, p. 144; Nordm. in Demid. Voy. Russ. Mérid. p. 388; Guichen. Exp. sc. Algér. Poissons, p. 50; Parnell, Fish. Frith of Forth, p. 43, pl. xxvii; White, Catal. Brit. Fish, p. 18; Thompson, Nat. Hist. Ireland, iv, p. 90; Günther, Catal. i, p. 473; Steind. Ich. Span. Port. 1867, p. 58.

Pagellus rostratus, Lowe, Trans. Zool. Soc. ii, p. 177.

Sparus pagrus, or Becker, Couch, Linn. Trans. xiv, p. 79.

Pagrus vulgaris, Yarrell, Brit. Fish. (Ed. 1) i, p. 102 (excl. synon. and figure), (Ed. 2) i, p. 116 (Ed. 3), ii, p. 138; Jenyns, Brit. Vert. p. 354; White, Catal. Brit. Fish, p. 17 (excl. synon.)

Sparus pagrus, Jenyns, Brit. Vert. p. 354 (part.)

Pagellus Canarensis, Val. in Webb and Berth. Hist. Nat. Iles Canar. Poiss. p. 35, pl. x, f. 2.

Pagellus Guntheri, Capello, Journ. Math. Phys. Nat. Lisbon, iii, p. 253, pl. iv, f. 3 (var. with 3 rows of molars in Cat. Fish. B. Mus. i, p. 474).

Erythrinus, Couch, Fish. Brit. Isles i, p. 233, pl. liii.

B. vi, D. $\frac{12}{10}$, P. 15. V. 1/5. A. $\frac{3}{8-9}$, C. 17. L. l. 56-60, L. tr. $\frac{6-7}{16}$, Cœc. pylori 4, Vert. 10/14.

Length of head $3\frac{3}{4}$ to 4, of caudal fin $4\frac{3}{4}$ to 5, height of body $3\frac{1}{4}$ to $3\frac{1}{2}$ in the total length. *Eye*—$3\frac{2}{3}$ to $4\frac{1}{2}$ diameters in the length of the head, from $1\frac{1}{2}$ to 2 diameters from the end of the snout, and the same apart. Interorbital space convex. Profile from shoulder to snout oblique, and the head somewhat compressed. Preorbital high, its height being 2/3 to 3/5 of its length: its lower edge scarcely emarginate. Jaws even in front: the maxilla reaches to almost beneath the front edge of the orbit. *Teeth*—anteriorly cardiform, with two rows of molars posteriorly in either jaw, but it is by no means rare to find 3 irregular rows of molars in the upper jaw, especially in large examples, but no other discernible differences: none on vomer, palatine bones or tongue. *Fins*—dorsal spines of moderate strength, the third somewhat longest from whence they decrease: rays shorter than the

spines, the last two not enlarged or scaled, but in some instances their bases approximate. Pectoral as long or even longer than the head. Ventral reaching the vent. Second and third anal spines of about the same length and strength. Caudal deeply forked. *Scales*—6 rows between the eye and the angle of the preopercle. *Cœcal appendages*—four, of which one is much larger than the remaining three. *Colours*—of an orange-scarlet having purple and silvery reflections, becoming light underneath: fins coloured as is the body: ventrals colourless, anal with a tinge of grey. In a large example, just captured, I observed blue spots over the body, likewise in some chads of this species, which abounded at Mevagissey when I was there in August, 1880, the usual length of which were about 8 inches.

Varieties.—I conclude Couch's *Becker* may be a deformed or mutilated example of this fish.

Names.—*Pandora, king of the breams. Le Pagel commun,* French.

Habits.—It is a migratory species, by no means uncommon, and most usually found during the summer and autumn, leaving as the cold weather sets in. Its habits seem to be somewhat solitary, and it is mostly taken at a depth of several fathoms. Off Nice it appears to be found throughout the year.

Baits.—Mussels are the favourite bait, but small fishes, crustacean animals and even sea vegetables are readily eaten.

As food.—Not esteemed in Britain.

Habitat.—This fish extends from the British shores to the Mediterranean where it abounds, and is found even in the Black Sea. Also in the Atlantic Ocean to the Canaries, while it has been reported from the Cape.

It is common in the British seas, on the south and west coasts of England, but becomes more rare to the north and in Scotland The *Spanish bream* recorded from Norfolk by Gurney as having been taken November 13th, 1846 (Zoologist, p. 1555), would appear from the description to be this species.

In Ireland Andrews has recorded it from the S.W. coast.

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* Holacanthus tricolor, Bloch. At the Zoological Society, January 20th, 1880, Dr. Günther exhibited a drawing of this tropical fish, "obtained on the coast of the Island of Lewes, and communicated to him by the Reverend George Gordon, who examined the specimen whilst in a fresh state. Dr. Günther stated that this was the first instance of this fish having reached the British coast." (P. Z. S. 1880, p. 23). This fish "was brought from Stornoway to Lossiemouth, it had been carried to Stornoway by the master of a small ship that had come from Glasgow, and the fish had not been caught at Stornoway by a herring-net or otherwise." (P. Z. S. 1880, p. 356). How it reached Lossiemouth in Morayshire *in a fresh state* is not recorded.

Family IV,—SCORPÆNIDÆ.

Sclerogenidæ, pt. Owen.

Branchiostegals five to seven: pseudobranchiæ present. Body oblong, compressed, or subcylindrical. Eyes lateral. Cleft of mouth lateral. Some of the bones of the head armed: suborbital ring articulated with the preopercle. Teeth in villiform bands. A single dorsal fin in two distinct portions: the anal usually similar to the soft dorsal: ventrals thoracic. Body scaled or scaleless. Air-bladder generally present. Pyloric appendages, when present, few or in moderate numbers.

Geographical distribution,—Almost cosmopolitan.

Genus I.—Sebastes, *Cuvier and Valenciennes.*

Pseudosebastes, Sauvage.

Branchiostegals seven: pseudobranchiæ present. Head and body somewhat compressed. No groove on the occiput, but usually a few small spines: preopercle armed. Villiform teeth on the jaws, vomer and mostly on the palatine bones. Fins not elongated: a single dorsal having the spinous more or less separated from the soft by a notch: spines 12 *to* 14: *anal not elongated having* 3 *spines: no free rays to the pectoral fin. Articulated fin-rays, excepting the lower ones of the pectoral, branched. No pectoral appendages. Scales present and of moderate or small size, extending as far forwards as the orbit or even beyond: no skinny appendages. Air-bladder generally present. Pyloric appendages few or in moderate numbers.*

Geographical distribution.—Marine fishes, extending from the Arctic regions throughout most seas, but rare or absent from the tropical portions of the Atlantic Ocean.

Sebastes Norwegicus, Plate XVIII.

Perca marina, pt. Linn. Syst. i, p. 483; Pennant, Brit. Zool. (Ed. 1) iii, p. 258, pl. xlviii, (Ed. 2) iii, p. 349, pl. lix.

Cyprinus pelagicus, Linn. Faun. Suec. p. 320.

Karfe, Olafsen, Island, i, p. 191, ii, p. 208, t. xxix.

Perca Norwegica, Ascan. Icon. ii, t. xvi; Müll. Zool. Dan. p. 46; Fabric. Faun. Groenl. p. 167.

Holocentrus Norwegicus, Lacép. iv, p. 390.

Holocentrus sanguineus, Faber, Fische Islands, p. 126.

Serranus Norwegicus, Flem. Brit. An. p. 212; Johns. Fish. of Berwickshire, Mag. Nat. Hist. 1833, vi, p. 15.

Sebastes Norwegicus, Cuv. and Val. iv, p. 327, pl. lxxxvii; Yarrell, Brit. Fish. (Ed. 1) i, p. 73, c. fig., (Ed. 2) i, p. 87, (Ed. 3) ii, p. 72; Jenyns, Brit. Vert. p. 347; Richards. Faun. Bor. Amer. Fish. p. 52; Storer, Rep. Mass. p. 26; Dekay, New York Fauna, p. 60, pl. iv, f. 2; Kroyer, Danm. Fish. Nat. Tids. 1844-45, i, p. 270; Thompson, N. H. Ireland, iv, p. 82; Günther, Catal. ii, p. 95; Malm. Efv. Sven. Vet.-Akad. Förh. 1865, p. 508; Collett, Norges Fiske, p. 19; Lütken, Vid. Medd. 1876. p. 358.

Sebastes marinus, White, Catal. Brit. Fish. p. 8.

Scorpæna Norwegica, Richardson, Faun. Bor. Amer. p. 52; Jenyns, Brit. Vert. p. 347; Johns. Berw. Nat. Club. 1838, i, p. 170.

? *Sebastes viviparus*, Kroyer, Nat. Tyds. 1844-45, i, p. 275; Gaim. Voy. Scand. Zool. Poiss. pl. vi; Günther, Catal. ii, p. 96; Gray, Ann. and Mag. Nat. Hist. (4) 1868, i, p. 312.

Sebastes septentrionalis, Gaim. Voy. Isl. and Groenl. Poiss. pl. ix.

Bergylt, Couch, Fish. Brit. Isles, ii, p. 3, pl. lviii.

B. vii, D. $\frac{15}{13}$, P. 20, V. 1/5, A. $\frac{3}{8-9}$, C. 13, L. l. ca. 75, Cœc. pyl. 9, Vert. 12/19.

Length of head 3 to $3\frac{1}{4}$, of caudal fin $5\frac{3}{4}$, height of body $3\frac{1}{2}$ to $3\frac{2}{3}$ in the total length. *Eye*—situated high up in the head, diameter $3\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and 1 apart. Interorbital space flat. A supraorbital spine. Five spines along the posterior and lower edges of the preopercle: two well developed opercular spines, one also at its lower angle and one at the shoulder. The maxilla reaches at least to beneath the middle of the eye. Lower jaw very prominent. *Teeth*—villiform ones on jaws, vomer, palatine bones but not on the tongue. *Fins*—dorsal spines strong and sharp, increasing in length to the 4th or 5th, but they are not so high as the rays, which are branched. Pectoral nearly as long as the head, its lower 10 or 11 rays simple and unbranched. Second anal spine the strongest, but the 3rd a little the longest. Caudal slightly emarginate. *Scales*—ctenoid and in irregular rows: there are about 15 between the lateral-line and the base of the first dorsal soft ray over the commencement of which fin some fine ones are continued. On the head they cover the cheeks and even the jaws. *Air-bladder*—oval, simple, and destitute of any appendages, occupying nearly the superior 2/3 of the abdominal cavity. *Colours*—vermilion or carmine-red, becoming lightest beneath: fins likewise red.

Collett, *l.c.* considers *Sebastes viviparus*, Kroyer, which has a large dark opercular spot, and is spotted with or entirely brown, as identical with this species. Lutken (Vid. Med. 1876, p. 358), after examining 20 of each variety, believes them to be distinct, *S. viviparus* being more littoral and less arctic in its range than *S. Norwegicus*. Gray, *l.c.* remarks on an example taken off Jutland.

I have already referred (p. 7) to this fish being *the Perch*, the head of which used to be shown in a church in Lapland, and has been erroneously considered as belonging to a gigantic *Perca fluviatilis*.

Names.—*Norway haddock* and *Norwegian carp*, which have reference to the locality where it abounds: *Bergylt*.

Habits.—Active, voracious, and apparently of a pugnacious disposition, it is said to feed on custacea and small flat fishes. As it is usually captured at profound depths, it is believed to usually reside there, especially in rocky bays, where the distance to the bottom is very great.

Means of capture.—Long lines baited as for cod or ling.

Breeding.—The young are said to be first observed about June, and it has been asserted that they come forth alive, and accompany their parent for a considerable time.

Diseases.—Nilsson observes that not uncommonly large numbers are found floating dying or dead on the sea, with their eyes protruding and their stomachs thrust out from their mouths. This is ascribed to some sudden whirlpool or other marine disturbance, having suddenly carried them into a higher stratum of water, when due to the superincumbent weight being removed, their air-bladder has expanded and occasioned the foregoing phenomena.

Uses.—In times, now probably gone by, the Greenlanders used the spines from the fins of this fish as needles.

As food.—Pennant says it was held in some esteem at the table: and Fabricius that, although lean, it is of an agreeable taste, and eaten either cooked fresh or after having been dried.

Habitat.—This fish is an inhabitant of the Northern Ocean. In Greenland it is stated not to be common (Saxby, Zool. 1871, p. 2553), occurring on the south-west coast of Spitzbergen (Malmgren, Œfv. Sven. Vet. Ak. Förh. 1865, p. 508), while in the Faroe Islands it is said to be frequently captured by the cod-fishers, and is termed *kongafisshur*, and *red-perch*, while it is not uncommon off Norway. It is likewise found in Greenland, where Saxby (Zool. 1871, p. 2553) states it is not common; it extends certainly as far south along the American coast as New York.

Pennant first recorded this fish as British: Fleming, who had also observed it in Zetland, remarked upon one seen by Dr. Skene on the coast of Aberdeenshire:

Couch, on the authority of Mr. McGregor, alludes to one caught near Macduff and another on the Morayshire coast: Gordon (Zool. p. 3458) speaks of an example 8 inches long from Lossiemouth in December, 1850, which was presented to the Elgin Museum: Edward (Life, p. 427) of a specimen taken in Banffshire in 1859. Dr. G. Johnson observed this fish near Berwick: and Mr. Tristram (Zool. 1867, p. 638) alludes to one about 13 inches long taken on January 27th, 1867, near Hartlepool, Durham, just after some severe weather. Yarrell records one 7 inches in length captured in Swansea Bay, October 26th, 1851.

Ireland.—In March, 1843, one was taken on a long line set for ling off Wildbank, Dingle Bay, where several more have since been captured (Andrews), and in 1850 two were secured on an 81-fathom line set for cod off Blasket Island, on the coast of Kerry.

This fish attains to 4 feet in length.

For the example figured, and which is 13 inches in length, I am indebted to Professor Hubrecht, of Leyden.

Second Group—Cotto-Scombriformes.

Dorsal fins placed close together or continuous, having fewer spines than rays: or the spinous portion may be modified into tentacles, detached spines, or a suctorial disk: anal similar to the soft dorsal, sometimes both fins are posteriorly modified into finlets: ventrals, when present, jugular or thoracic, never forming a sucker. No prominent anal papilla.

Family, V—COTTIDÆ.

Branchiostegals from five to seven: pseudobranchiæ present. Body oblong or subcylindrical. Eyes lateral or directed upwards. Cleft of mouth lateral, sometimes extending on to the sides of the snout. Some of the bones of the head armed: suborbital ring articulated with the preopercle. Teeth in villiform bands. One or two dorsal fins, the spinous portion of which is less developed than the soft portion or than the anal: ventrals thoracic. Body scaled, scaleless, or with a few plates. Air-bladder present or absent. Pyloric appendages, when present, few or in moderate numbers.

Geographical distribution.—Cosmopolitan, and found in fresh or saline waters.

Genus I.—Cottus.

Phobetor, Kroyer. *Boreocottus*, *Porocottus* and *Ceratocottus*, Gill. *Aspicottus*, *Acanthocottus*, *Leiocottus*, *Uranidea*, *Tauridea*, *Potamocottus* and *Triglopsis*, Girard. *Ptyonotus*, Günther. *Elaphocottus*, Sauvage.

Branchiostegals six: pseudobranchiæ present. Body subcylindrical anteriorly, compressed posteriorly. Head broad, depressed and rounded in front. Angle of preopercle with a single spine (having an antler-like process in some exotic species). Villiform teeth in the jaws, usually (but not invariably) present on the vomer, absent from the palatine bones. Two dorsal fins: pectorals rounded, some or all the rays unbranched. Ventrals thoracic. Head and body covered with a soft skin. Lateral-line present. Air-bladder absent. Pyloric appendages in moderate numbers.

Habits.—These fishes, whether inhabiting the fresh or the salt waters, conceal themselves under stones or among weeds. They are ground feeders, living on small crustacea or any animal substance, including fish-eggs. Some of the marine forms appear to keep close to the lowest ebb of the tide. When captured they distend their heads, causing the spines with which they are armed to protrude. They live some time after their removal from the water. The largest variety (*C. Grœnlandicus*) is reputed to attain to 6 feet in length, pursues its prey with rapidity, killing blennies, herrings, codfish, and even salmon. Dufosse, 1872, p. 360, has mentioned the sounds emitted by *C. scorpius* and *C. bubalis*.

Means of capture.—They readily take a bait or are captured with small nets. Marine forms are frequently taken in crab-pots. The Greenland variety is said to be fished for in that country with long lines baited with a white bone, glass bead, or a piece of red rag. Aristotle alludes to the occurrence of little fish in certain rivers where they are found under stones, they are termed by some people *Cotti*. Owing to their lying under stones persons catch them by striking these stones with pieces of rock, when the fish, being stunned, fall out.

As food.—Those obtained in Great Britain are considered too small to be worth cooking, but the larger forms are of economic value in Greenland, where we are informed the bull-heads are used for making soup, but the more artistic cooks of France reject them for this purpose.

Varieties.—The number of fin rays, the proportion which are divided at their

extremities or not so, the length of the ventral fin, situation of the lateral-line and position of the vent, appear to be subject to considerable variations in this genus, even in the same locality, yet they have been accepted by some ichthyologists as reasons for according specific rank, whereas others have only deemed them to be varieties or sub-species. As in examples of this genus these variations are not always permanent ones, I have considered them to be varieties, as only in permanence of variation can species be admitted.

Geographical distribution.—Arctic regions of Europe, Asia and America, also North Atlantic Oceans of both hemispheres descending into temperate zones: found both in salt and fresh waters. One or two species have been recorded from Japan.

Cottus gobio, Plate XIX, fig. 2.

Βοιτος, Arist. iv, c. 8.

Chabot, Belon. p. 213. *Cottus*, Rondel. ii, p. 202. *Cottus fluviatilis*, Gesner, f. 162 *a*; Aldrov. v, c. 28, p. 613; Willughby, p. 137, t. H. 3, f. 3; Ray, p. 76. *Gobio capitato*, Jonston, De Pisc. lib. iii, t. i, c. 10, Art. xi. *Koppe*, Gronov. Zooph. No. 270; *Cottus*, sp. 1, Artedi, Gen. p. 48, spec. p. 82, synon. p. 76. *Cottus lævis*, Marsigli, Danub. iv, t. xxiv, f. 2. *Percis*, sp. Klein, Mss. v, p. 43, No. 17. *River bullhead*, Pennant, Brit. Zool. (Ed. 1) iii, p. 216, pl. xxxix, (Ed. 2) iii, p. 291, pl. xliii; Bowdich, Brit. F. W. Fish. No. 24.

Cottus gobio, Linn. Syst. i, p. 452; Fabr. Fauna Groenl. p. 159; Gmel. Linn. p. 1211; Gronov. Mus. Ich. ii, p. 14; Bloch, t. xxxix, f. 1, 2; Bl. Schn. p. 61; Lacép. iii, p. 252; Donovan, Brit. Fish. iv, pl. lxxx; Turton, p. 94; Shaw, Zool. iv, p. 254, pl. xxxv; Jurine, Poiss. Lac Leman, pl. ii; Cuv. and Val. iv, p. 145; Fleming, Brit. An. p. 216; Ekstrom, Fiske Mörkö, p. 167; Fries och Ekstrom, p. 34, t. vii, f. 2; Yarrell, Brit. Fish. (Ed. 1) i, p. 56 c, fig. (Ed. 2) i, p. 71, (Ed. 3) ii, p. 48; Jenyns, Brit. Vert. p. 343; Swainson, Fishes, ii, p. 271; Thompson, Nat. Hist. Ireland, iv, p. 80; Günther, Neckarfische, p. 17 and Catal. ii, p. 156; Gronov. ed. Gray, p. 103; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 376; White, Catal. Brit. Fish. p. 6; Schlegel, De Dieren van Nederl. p. 46, pl. v, f. 3; H. Malm, Weigm. Arch. 1864, p. 272; Blanchard, Poiss. France, p. 161, c. fig.; Houghton, British F. W. Fish. p. 7, c. fig.

Cottus minutus and *ventralis*, Cuv. and Val. iv, pp. 152, 194.

,, *tricuspis*, Reinh. sen. Kgl. D. Vid. Selsk. Nat. Math. Afhand. B. 5, p. lii, 1829-30.

Cottus pœcilopus, Heckel, Ann. Wien. Mus. ii, 1839, t. viii, f. 1, 2; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 377; Gunther, Catal. ii, p. 157.

Cottus affinis, Heckel, Ann. Wien. Mus. ii, p. 145, t. viii.

,, *microstomus*, Heckel, l. c.; Nord. l. c. iii, p. 377; Heckel and Kner, Susswasserf. p. 32.

Cottus ferrugineus, Heckel and Kner, l. c. p. 34.

Miller's thumb, Couch, Fish. Brit. Isles, ii, p. 6, pl. lix.

Phobetor ventralis, Collet, Norges Fiske, p. 30.

B. vi, D. 6(-8) | 16-17 (18), P. 14, V. 1/4, A. 12 (-14), C. 11. Cœc. pyl. 4, Vert. 10/23.

Length of head 4 to $4\frac{1}{4}$, of caudal fin $6\frac{1}{2}$, height of body $5\frac{1}{2}$ in the total length. *Eyes*—supero-lateral, placed just anterior to the middle of the length of the head and 1 diameter apart. Head broad and depressed, while the gill-covers are generally found distended, showing this still more clearly after death: behind the head the body gradually decreases in size and becomes laterally compressed. Cleft of mouth shallow, its gape wide: the posterior extremity of the maxilla reaches to beneath the middle of the eye. Upper surface of the head covered with a soft moveable skin, which has numerous minute elevations encircling the opening of pores, the same being continued to over the first third of the body. A rather strong, backwardly-directed spine exists at the angle of the preopercle and occasionally another at its base: a strong forwardly-directed spine at the anterior-inferior angle of the subopercle: no other spines on the head. Anterior

nostril tubular: the posterior patent: no barbels. *Teeth*—fine in the jaws and in a horse-shoe shaped band on the vomer: none on the palatine bones or on the tongue. *Fins*—first dorsal spines weak and about half as high as the rays of the second dorsal: the two fins are usually slightly connected at their bases. Ventral rays unbranched, the fin does not normally in British examples reach the vent. Pectoral rays unbranched. Vent situated about midway between the snout and the base of the caudal fin. *Intestines*—the length of the intestinal tract almost equals that of the entire fish excluding the caudal fin. Four cœcal appendages. *Scales*—absent: but in some examples the skin of the upper half of the body studded with little rough points. *Lateral-line*—about the middle of the depth of the body or slightly nearer the back: it consists of about 33 tubes. Ovi-sac black. *Colours*—greenish-yellow, lightest beneath. Banded, striped, or irregularly spotted with black: a light band, often of a V-shape across the occiput. Fins orange: a dark band along the middle of the first dorsal fin: the others with dark bands of spots.

Varieties.—The different varieties generally admitted to belong to this species are divisible into:—

A. Pectoral fin, with 7 or 8 branched rays. France.
B. Pectoral fin, without branched rays.
  a. Ventral rays branched. Scandinavia.
  b. Ventral rays simple. England, Germany, Austria.

Cottus pœcilopus is stated to have D. 8-9 | 16-18, A. 13-14, the lateral-line running above the middle of the height of the body and ceasing prior to reaching the base of the caudal: ventral fin inserted midway between the snout and the base of the caudal fin, while it reaches the vent. I have a beautiful example, 4½ inches in length, sent me by Professor Giglioli of the Florence Museum; it has D. 8/17, V. 1/4, all simple: 5 upper pectoral rays branched. A. 12. Vent midway between the snout and the base of the caudal fin: lateral-line median and just reaching the base of the caudal fin. Ventral fin nearly reaches the vent, at any rate as closely as is seen in the examples of *C. pœcilopus* in the British Museum. In Cuv. and Val. it is stated that the French *C. gobio* has from 6 to 8 or even 9 dorsal spines; the second dorsal 17 to 18 rays; and the anal 13. Blanchard, l. c. says of the French form it sometimes has 7 or 8 dorsal spines, that the second dorsal fin has usually 17 rays: that in some examples all the pectoral rays are simple, in others the upper 7 or 8 are branched; while the anal has up to 13 or 14 rays. Unless my fish from the Florence Museum is considered a new species, it must be admitted to be a link between *C. pœcilopus* and *C. gobio.* Irrespective of this, Girard in his elaborate monograph on the North American Cottoids, remarks having seen "a mutilated specimen of an English miller's-thumb, with evidently branched pectoral rays," thus showing, not that two species exist in Britain, but that whether the pectoral rays are branched or unbranched, may occur in fishes from the same locality, and must be regarded as a variable and inconstant sign of no specific value.

Respecting the situation of the vent, Richardson observed that in *C. cognatus* "the anus situated precisely as in *C. gobio*, is rather nearer the snout than the insertion of the caudal." One author states the vent in *C. gobio* to be rather nearer the snout than to the tip of the caudal. Examining eight Gloucestershire examples from 2·50 to 2·90 inches in length, captured the same morning, I found their average entire lengths were 2·69 inches: and the average distance from the snout to the vent 1·19, while the average length of the caudal fin was 0·43. The vent in some was equidistant between the snout and the base of the caudal fin: in others, between the snout and the first fourth of the caudal fin. Much the same proportions are likewise present in the British Museum examples, whether British, Swedish, Austrian, or from Dalmatia. In the example of *C. gracilis* in the National Collection, 2·30 inches in length, the vent is 1·10 inches from the snout, being very little different from what is seen in some similarly-sized Gloucestershire specimens of *C. gobio.*

As to the position of the lateral-line. In Leach's example, 2·90 inches long, from Devonshire, the distance from the vent to the lateral-line is 0·45 inches,

while from it to the back is 0·34 inches, showing that it is placed nearer to the back than to the inferior surface of the body. In *C. pœcilopus*, 3·80 inches long, and in the British Museum, the distance from the lateral-line to the vent is 0·50 inches, while from the back it is 0·25 inches.

The species of fresh water *Cottus* appear to have been very unduly multiplied, while if every variation is to be looked upon as the type of a distinct species, many more will have to be admitted.

Names.—*Miller's-thumb*, due to its fancied resemblance to that digit in a miller. "The thumb," says Yarrell, "by a peculiar movement spreads the sample over the fingers, and employed with tact becomes the gauge of the value of the meal produced. Hence the saying, 'worth a miller's thumb.'" By constant use the miller's thumb is reputed to acquire a form resembling the shape of this fish: *bull-knob* or *bull-jub*, Derbyshire: *cull*, Gloucestershire and in some other counties: *cob*, according to Florio (see *Clupea harengus*) : *cod-pole*, Buckinghamshire and Berkshire: *noggle-head*, South Hampshire: *horbeau*, Kent, also *tom-cull* and *tommy-logge*. *Pentarw* and *bawd y melinydd*, Welsh. *Chabots* and *chaboisseaux*, French. *De rivier-donderpad*, Dutch.

Habits.—It usually lurks on the gravel at the bottom of clear streams or under a stone. Here it feeds on insects and their larvæ, worms, small crustacea and fish eggs, or conceals itself if pursued by enemies. Although it can dart for a short distance rapidly through the water, it has no power of maintaining swimming for any long distance, and never suspends itself in mid-water. It is a voracious feeder, delighting on fish eggs or the young fry. It is most tenacious of life even after removal from the water. Although it inflicts wounds with its spines, these do not occasion the poisonous symptoms occasioned by the marine weever, *Trachinus*, and that the cause of this difference is that it is a fresh-water species cannot be sustained, as the scorpion fish, *Saccobranchus fossilis*, of Asia, is always an inhabitant of fresh water.

Newman* observed upon one which he kept, that it is curious to perceive how readily the tints change, as may be seen in an aquarium, irrespective of changes in accordance with the colour of the ground, the swallowing a worm, the effect of a swimming adventure, and on one occasion the extrusion of ova. In short, the fish could not have been recognized under its altered aspect.

Means of capture.—Searching under stones in streams and capturing them by small nets or by the hand; in the latter process they are found difficult to grasp owing to the slippery character of their skins. They will take a small hook baited with a red worm. In Switzerland children are said to spear these fishes in the streams as they dart from one stone to another. Cuvier considered this fish as a good bait for an eel.

Breeding.—It deposits its ova in March or April under stones or in a hole it forms in the gravel, and from which it is difficult to drive it. Whether both sexes protect the eggs, or if only one, which it is does so, has been subject to discussion. Marsigli asserts that the female rests for the space of a month on the eggs, which are comparatively large and of a pinkish colour, the whole constituting a mass covering about 1½ inches of ground, and invested by an adherent mucus. Jonston and Willughby followed him, and stated that the female collects the spawn into lumps on her breast, where it is covered with a thick secretion, and here they remain until the young come forth. Fleming affirms that it deposits its spawn in a hole in the gravel; and Blumenbach that it keeps watch over its nest. Newman tells us that one which he kept in an aquarium deposited its ova on the night of Good Friday, that the mass was nearly as large as a sparrow's egg, closely adherent, and somewhat resembling frog's spawn.

As food.—It has been asserted that this fish is good eating, and is employed for food in Italy. In some localities its flesh becomes pink when boiled, but not so in others.

* Zoologist, 1856, xiv., p. 5124.

Owls have been observed to eat bull-heads and also to give them to their young. In the Angler's Note Book (1880, p. 177) is an account of a dead grebe which was found in the Isis having one of these fishes in its throat: it had been swallowed head first, and its opercular spines had stopped its further progress.

Pallas observes that in Russia this fish is employed as a charm against fevers.

Habitat.—Fresh waters generally, streams of Europe from Greenland and Scandinavia to Italy, and perhaps Northern Asia. In Scandinavia it is reputed to descend into the Baltic. It is said not to be found south of the Pyrenees nor in Greece. In America it extends from near the Arctic circle as far as North Carolina.

In Great Britain it is common in most of our clear brooks. Although Yarrell observes that it is found in Belfast and Londonderry, Thompson considers he was mistaken, and that it is entirely absent from Ireland. In Sampson's Derry, p. 337, he alludes to the existence of this fish, which is also in Brown's list.

It grows to about 5 inches or more in length; but "in Siberia it sometimes attains," according to Donovan, "to the length of half a foot or even seven inches." The example figured was from the Churn at Colesbourne on the Cotswold Hills.

1. **Cottus scorpius,** Plate XIX, fig. 1, and XX, fig. 1.

Cottus, sp. 3. Artedi, Gen. p. 49, sp. 86; Gronovius, Zooph. p. 78, no. 268. *Corystion*, Klein, Mss. iv, p. 47, no. 11, t. xiii, f. 2, 3.

Cottus scorpius (pt.) Linn. Syst. Nat. i, p. 452; Bloch, t. xl; Gmel. Linn. p. 1210; Lacép. iii, p. 236; Bl. Sch. p. 61; Shaw, Zool. iv, p. 257, pl. 36; Donovan, Brit. Fish. ii, pl. xxxv; Turton, p. 95; Cuv. and Val. iv, p. 160; Flem. Brit. An. p. 216; Jenyns, Manual, p. 344; Thompson, P. Z. Soc. 1835, p. 80, and Nat. His. Ireland, iv, p. 80; Ekström, p. 171; Fries och Ekstr. p. 23, pl. v, f. 1, 2; Hogg, Nat. Hist. Stockton, p. 26; Templeton, Mag. Nat. His. 1837, (2) i, p. 409; Yarrell, Brit. Fish. (Ed. 1) i, p. 60, c. fig. (Ed. 2) i, p. 75; Johnston, Berwick. Nat. Hist. Club, 1838, i, p. 170; Parnell, Fish. Frith of Forth, p. 23; Swainson, Fishes, ii, p. 271; White, Catal. p. 6; Gronov. ed. Gray, p. 102; Günther, Catal. ii, p. 159; Malm, Œfv. Sven. Vet. Akad. Fork. 1865, p. 495; Fabric. Faun. Gröenl. p. 156; Faber, Fisc. Isl. p. 120; Collett, Norges Fiske, p. 24; McIntosh, Fish. St. Andrew's, p. 172; Lütken, Vidd. Medd. 1876, p. 370.

Cottus Grœnlandicus, Cuv. and Val. iv, p. 185; Richards. Faun. Bor. Amer. iii, pp. 46, 297, pl. 95, f. 2; Storer, Rep. Mass. p. 16; Dekay, N.Y. Fauna, Fish, p. 54, pl. iv, f. 10; Thompson, N. H. Ireland, iv, p. 81; Günther, Catal. ii, p. 161; Gill, Pro. Phil. Soc. 1872, p. 213.

Cottus porosus, Cuv. and Val. viii, p. 498; Richardson, Fau. Bor. Amer. Fish. p. 47.

Cottus glacialis, Richardson, l. c.

Cottus variabilis, Ayres, Pro. Boston Soc. Nat. Hist. 1842, p. 68, and Boston Journal, iv, 1843, p. 259.

Acanthocottus Labradoricus and *A. variabilis*, Girard, Boston, J. N. Hist. vi, 1850, p. 247, pl. vii, f. 3, and p. 248.

Acanthocottus ocellatus, Storer, Boston J. N. Hist. vi, p. 253.

Acanthocottus scorpius and *Grœnlandicus*, Yarrell, Brit. Fish. (Ed. 3) ii, pp. 54, 56, c. fig.

Father-lasher and *Greenland Bull-head*, Couch, Fishes Brit. Isles, ii, pp. 8, 12, pl. lx, lxii.

B. vi, D. 9-10 | 13-14 (16-17), P. 16-17, V. 2, A. 9-13 (14), C. 11, Cœc. pyl. 9-11, Vert. 12-13/22.

Length of head $2\frac{3}{4}$ to $3\frac{1}{4}$, of caudal fin $5\frac{1}{2}$ to 6, height of body $4\frac{1}{4}$ to $4\frac{1}{2}$, in the total length. *Eye*—4 to $4\frac{3}{4}$ diameters in the length of the head, 1 diameter from the end of the snout, and 2/3 of a diameter apart; the orbits being 1/3 more distant asunder opposite their hind margins than they are opposite the middle of the eyes. Head wide and depressed, covered with a soft skin, which is studded

with minute elevations or fine open pores. Interorbital space concave. The maxilla reaches to beneath the middle or last third of the orbit. A pair of small turbinal spines, situated internally to the nostrils; an obtuse one at the posterior superior angle of the orbit; supra-scapular with a larger and sharper spine and another on the scapular. Preopercle with two spines on its posterior edge, the upper of which is the longer: a small one directed forwards exists at its anterior-inferior angle. Opercular spine well developed, also another at the angle of the subopercle. Interopercle with a small spine. *Teeth*—small ones in the jaws, and on a V-shaped patch on the vomer, none on the palatines or on the tongue. *Fins*—spines of the first dorsal weak and flexible, the longest not quite twice the length of the eye; rays of the second dorsal and of the anal undivided. Pectoral reaches to above the vent. The ventral in the young reaches the vent but not so far in adults. Caudal cut square with its eight middle rays divided at their extremities. *Scales*—skin smooth, but in some individuals with several granulated plates. *Lateral-line*—smooth. *Intestines*—vent much nearer the base of the caudal fin in some examples, in others nearer to the snout, while all intermediate gradations may be observed. *Colours*—grayish superiorly, mottled and banded with black: lower surface of a dull white dashed with yellow. The males with white spots on the abdomen, sometimes edged with red or yellow. Fins yellow with oblique dark bands, bars and spots, which are often of a dull red.

Varieties.—Form—the spines at the angle of the preopercle are occasionally only 2 (instead of 3) in number, while they may differ on the two sides of the head in the same example. Thompson obtained a female with 4 spines on one preopercle, 3 on the other. In all my specimens from Southend the anal fin has from 9 to 11 rays. The number of dorsal spines may be as few as 8 (Cuv. & Val.), but I have not found less than 9 in British examples; while the anal rays vary from 9 to 13. That a decrease in the numbers occurs as the fish is further from the north is very significant. Malmgren has pointed out that Scandinavian examples have generally two more rays in the dorsal fin than those from the more temperate west coasts of Europe. With a species however which shows so many variations in the number of its fin rays, and with an evident tendency to degenerate the further it is from the Arctic region, this cannot be a subject for wonder, and as no other differences have been observed, we may fairly conclude that the southern is merely a variety of the northern species. It has been remarked that the inner portions of the pectoral and ventral fins are rough in *C. Grœnlandicus*, but not so in *C. scorpius:* this however is an error, as they are equally rough in large examples of *C. scorpius.* The number of cœcal appendages varies between 9 and 11. *Colour*—Gill first drew attention to those with white spots being males.

Names.—Sting-fish: Sea Scorpion: Short-spined Cottus. Gundie, Scotch. *Sutor*, in Moray Frith (Gordon, Zool. p. 3458). A correspondent in the Angler's Note Book, p. 119, mentions that an old work in Cornwall alludes to the *poison-pate* (*poisson*) which he thinks might be this fish (*? Trachinus*). *Sarph y môr*, Welsh. *Le Chaboisseau de mer commun*, French.

Habits.—Residing along the coasts, keeping just within the influence of the waves, or in pools left by a receding tide, concealing itself under stones or sea-weed, from which it emerges when in pursuit of prey, or changing its locality. It is not uncommon in bays where much fucus abound. It is very wary, permitting the hand to approach to within a couple of inches before it quits its post, but then darting away with great rapidity. McIntosh observes that it lives on small sucking fishes (*Liparis*, &c.) shrimps, and *Terebellæ*, while fragments of green *Algæ* occur in its stomach; in short it is very voracious, swallowing any animal not too large. When captured it closes its gill-covers and distends its head and branchiostegal membranes to much above their ordinary width, while at this time according to Couch "there may be felt such a trembling at the throat, as might suggest the opinion that it proceeds from an effort to produce some sort of sound that would be perceived in its natural element." It lives some time after removal from the water, especially if its skin is kept moist; but although fresh

water is said to be fatal to its existence, such cannot always be the case. Mr. Gurgon states (Zool. 1844, p. 1216) that in the summer of 1843 he took several, which are locally termed "rock dolphins," with a hand-line from off the Brighton chain-pier. One was kept half-an-hour out of water, and subsequently seven hours in fresh water, it was then while apparently quite well transferred to sea water and took no notice of the change. It died during the night. Adult forms of *C. Grœnlandicus* are found to be active and swift when pursuing their prey, following them even to the surface, devouring blennies, herring, cod, and even salmon, but it must be remarked that these fishes in the Arctic Ocean are said to attain to six feet in length. Donovan observes that they will follow sharks and other voracious fishes with the greatest temerity, lashing and wounding them with their spines, and effectually driving them from those places where they are accustomed to hunt themselves: to the blennies it is a desperate enemy.

Breeding.—In Greenland it has been observed to deposit its eggs on the sea-weed in December and January. Its eggs are very small, and in this country are extruded during the spring in the sand or pools in rocks. The male is said to make a nest of sea-weeds and pebbles for the reception of the spawn, while he is also believed to watch over as well as to protect the young when hatched.

Baits.—I found in the stomach of the one figured (natural size on plate xx) a crab one inch across the carapace. It readily takes a bait: according to Crantz, in Greenland it resorts to the deeper waters of the bays and is fished for with long lines, the bait used being a white bone, glass bead, or piece of red cloth: four hooks are used placed cross-wise. They are occasionally speared.

As food.—Not used in this country, but appears to be approved of in Greenland. The males, however, are said in *Skandinaviens Fiskar* to be considered poisonous, while the females are eaten by the poor.

A fisherman, annoyed at finding one of these fish among his shrimps, attempted to bite off its head, when it struggled, escaped into his throat, became fixed in his larynx and occasioned suffocation. (Angler's Note Book, 1880, p. 177.)

Habitat.—From the Arctic Ocean and North Atlantic in both hemispheres, the North Sea and the Baltic, round the British Isles. In Newfoundland *C. Grœnlandicus* is abundant (Saxby, Zool. 1871, p. 2553). The British form must be considered a degenerated variety of the Greenland bull-head.

Common round the British coast, and very numerous in the Orkneys and Shetland Isles. The variety, *C. Grœnlandicus*, was taken in 1858 in a salmon-net, at Montrose (J. Richardson, Zoologist, 1860, p. 6993): while in 1880 large numbers of the British variety were received at the Westminster Aquarium from Brighton, and which had the brilliant Greenland livery.

Found in Ireland all around the coast throughout the year, especially in small bays where much *Fucus* abounds. *C. Grœnlandicus* has been taken on south-west coast of Ireland in Dingle Harbour, in February, 1850.

In Greenland, as already observed, this fish is said to attain to 6 feet in length, the largest recorded example in Great Britain being 15 inches.

2. Cottus bubalis, Plate XX, fig. 2.

Cottus, Artedi, Gen. p. 49, sp. p. 86; Gronovius, Zooph. no. 268; *Sea Scorpion*, Edward, 284; Tonning in Trondhj, Selsk. Skr. ii, p. 345, t. xiii, xiv; *The Father-lasher*, Low, Faun. Orcad. p. 206.

La scorpene, Belon. p. 242. *Scorpius marinus*, Schonevelde, Ich. p. 67, t. vi; Jonston, De Pisc. t. xlvii, fig. 4. *Scorpœna Belonii similis*, Wil. Ich. p. 138, t. H. 4, f. 3; Ray, Pisc. p. 145.

Cottus scorpius, pt. Linn. Syst. Nat. i, p. 452, and Fauna Suec. No. 323; Pennant, British Zool. (Ed. 1), iii, p. 218, pl. xl (Ed. 2), iii, p. 294, pl. xliv; Gronov. ed. Gray, p. 102.

Cottus bubalis, Euphrasen, N. Schwed. Abhandl. vii, 1786, p. 64, t. iii, f. 2, 3; Bloch, Schn. p. 62; Cuv. and Val. iv, p. 165, pl. lxxviii; Yarrell, Zool. Journ. iv, pp. 470, 508, Brit. Fish. (Ed. 1), i, p. 63, c. fig. (Ed. 2), i, p. 78 (Ed. 3), ii, p. 58; Jenyns, B. Vert. p. 345; Ekström, Fische Mörkö, p. 182; Fries och Ekstr. p. 27, t. vi, f. 1, 2; Thompson, Pro. Z. S. 1835, p. 80; Nat. Hist. Ireland, iv, p. 81;

Johnston, Berwick. N. F. Club, 1838, i, p. 170; Parnell, Fish. Frith of Forth, p. 25; White, Catal. p. 7; Günther, Catal. ii, p. 164; Steind. Meeresfische Span. und Port. p. 92; Collett, Norges Fish. p. 29; McIntosh, Fish. St. Andrew's, p. 172.

Aspicottus bubalis and *bison*, Girard, Pro. Acad. Nat. Sc. Phil. 1854, p. 130.

Bubalis, Couch, Fish. Brit. Isles, ii, p. 11, pl. lxi.

B. vi, D. 8 | 11—12, P. 16, V. 1/3, A. 9, C. 10, Cœc. pyl. 7-8, Vert. 12/17.

Length of head $3\frac{1}{4}$, of caudal fin 5 to $5\frac{1}{2}$, height of body $3\frac{3}{4}$ to $4\frac{1}{4}$ in the total length. *Eyes*—diameter about 1/4 of the length of the head, being superiorly merely separated by a narrow and furrowed interspace. Head wide and depressed, covered with a soft skin, opening on which are many small mucous pores. The maxilla reaches to beneath the middle or last third of the orbit. Turbinal spines well developed. Preopercle with four spines, the superior being the longest and exceeding the length of the diameter of the eye, the inferior one pointing downwards and forwards: a ridge from the orbit ends in a spine at the occiput, another at the supra-scapular and scapular. Opercle with a spine, the base of which is granulated: two subopercular spines, the lowest pointing downwards and forwards. A few small tentacles about the head and above the eyes, and usually one at the end of the maxilla. *Teeth*—moderately sized villiform ones in the jaws and on the vomer, none on the palatines or on the tongue. *Fins*—the first dorsal not so high as the second, its spines rather weak: all the rays of the second dorsal simple. Pectoral reaches the origin of the anal, its rays undivided. Ventral not extending to the vent. Anal rays simple. Caudal cut square, its eight central rays divided at their extremities. *Skin*—smooth. *Lateral-line*—with some bony plates, most distinct in its anterior portion. Vent rather nearer the base of the caudal fin than the snout. *Colours*—on March 8th, 1880, I received a beautiful male specimen, 6 inches in length, from Mr. Dunn of Mevagissey. All the dark markings were of a brilliant carmine, while it had some large and irregularly shaped white spots along the sides and white vermiculations on the under side of the head. As a rule the fish is of a light brown, with darker and irregular blotches and bands: likewise oblique dark bands on the dorsal and anal fins, and vertical ones on the pectorals and caudal.

Varieties.—Form.—The American species has been stated to have the ridges on the head tubercular and not covered by skin, but I find this also in some British examples. The variety of *Cottus scorpius* mentioned by Couch as having "a row of tendrils, hanging from the skin above the eyes," seems to agree with this species. In *colour* we likewise find variations. A beautiful example $4\frac{1}{2}$ inches in length was captured at Southend early in April, 1879. The under surface was brilliantly yellow, and on it were some large white marks; while the under surface of the pectoral fin was spotted with pure white and brown (P. 15). Another 7 inches long was without these white spots, but it and the last-mentioned had well developed filaments at the end of the upper maxilla.

Names.—Father-lasher: Long-spined cottus. Lucky proach, Scotch.

Habits.—Lurks under stones, pieces of rocks, or in similar situations, watching for small fish and crustacea: and Couch considered that it preferred deeper water to that selected by *C. scorpius*. Mr. Gurney placed one which was $2\frac{1}{2}$ inches in length in a vessel of sea water, which contained some sand launces that were about 3 inches long. It was observed to seize one and swallow it head first, deglutition lasting $1\frac{1}{2}$ hours (Zool. p. 2954.) Low observes, "I once saw a trial of skill between a large one of this kind and a cormorant. The latter got the head and part of the body of the fish swallowed, but being wounded by the spines, I suppose, attempted to bring it up again: however, this was not practicable, for these being placed the contrary way, hindered its return, and acted the same part as the barb of a hook, in fixing it firmer in the throat of the cormorant, which, after many attempts and much struggling, was killed by it." The fish was $12\frac{1}{2}$ inches long, its spines were fastened in the bird's throat.

Mr. Dunn, writing of the carmine coloured example of this fish which he sent me, observes: "it was brought to me about 9 a.m. alive in a bucket of water: then being removed from the water it was put on a table and left there seven

hours, subsequently it was found alive and well, recovering on being placed in water."

Means of capture.—Frequently taken in crab pots, which have been set where sand and low rocks are intermingled.

Breeding.—In December and January, the ova being large and of an orange colour.

As food.—It is common in the seas of Newfoundland, where, says Pennant, it is called *scolping;* it is also frequent in deep waters along the coasts of Greenland and is the principal food of the natives, and soup made of it is declared to be both wholesome and agreeable. Low observes that "it is reckoned delicate eating, and those who can put up with its horrid appearance, prefer it to others, which are more beautiful to the eye."

Habitat.—From the Arctic regions in both hemispheres, the Baltic, North Sea, British Isles, and coasts of France and Spain.

In the Orkneys it is found in every pool into which the sea flows regularly (Low). According to Baikie it is not so common in the Orkneys and Zetland as *C. scorpius.* It is found all round the British coasts. Edward observes that in Banffshire it is abundant in pools left by the tide or beneath stones at low water.

Ireland, *C. bubalis* is more common, according to Thompson, than *C. scorpius;* it has been reported from Antrim, Down, Kerry, etc.

It attains to 12 or 13 inches in length.

3. **Cottus quadricornis**, Plate XXI.

Cottus, Sp. 2, Artedi, Genera, p. 48 and spec. p. 84; Gronov. Zoophyl. p. 79, No. 272.

Cottus quadricornis, Linn. Syst. i, p. 451; Pallas, Spic. Zool. viii, p. 25; Bloch, t. cviii; Gmel. Linn. p. 1208; Bl. Schn. p. 62; Bonaterre, Ency. p. 67, pl. xxxvii, f. 146; Shaw, Zool. iv, p. 259, pl. 36; Lacép. iii, p. 241; Cuv. and Val. iv, p. 168; Ekström, Fische Mörkö, p. 178; Fries och Ekstr. p. 30, t. vii, f. 1; Yarrell, Brit. Fish. (Ed. 1), i, p. 68, c. fig. (Ed. 2), i, p. 83 (Ed. 3), ii, p. 64; Jenyns, p. 345; White, Catal. Brit. Fish. p. 7; Gronov. ed. Gray, p. 102; Günther, Catal. ii, p. 166 and Proc. Zool. Soc. 1877, p. 293; Malm. Wieg. Arch. 1864, p. 275; Lütken, Vidd. Medd. 1876, p. 375.

Cottus hexacornis, Richards. Franklin Journal, p. 726, and Faun. Bor. Amer. Fishes, p. 44; Günther, Catal. ii, p. 166.

Four-horned cottus, Couch, Fish. Brit. Isles, ii, p. 15, pl. lxiii.

B. vi, D. 9/14, P. 17, V. 1/3, A. 13-15, C. 13, Cœc. pyl. 6 or 7. Vert. 40.

Length of head $3\frac{3}{4}$, of caudal fin $6\frac{2}{3}$, height of body $4\frac{2}{3}$ in the total length. *Eye*—$4\frac{1}{2}$ diameters in the length of the head, $1\frac{1}{4}$ diameter from the end of the snout and also apart. Two pairs of large and rough tubercles on the upper surface of the head, one over the posterior superior angle of each orbit, the other on the nape, the space enclosed by these four points being longer than wide. Three or four preopercular spines, the superior being the longest and equalling the diameter of the orbit. A pair of turbinal spines. The maxilla extends posteriorly to beneath the middle of the orbit. *Teeth*—villiform in the jaws and vomer. *Fins*—first dorsal low, the third or fourth spines being the longest and less than half the height of the body below them, and only two-thirds the height of the second dorsal. Pectoral reaches to above the vent. Ventral reaches scarcely half-way to the anal. Caudal rounded. All the rays, except the central ones of the caudal fin, unbranched. *Scales*—absent, a row of rather large granular tubercles between the lateral-line and the back, and sometimes a second of smaller ones: below the lateral line one or two similar rows, while occassionally others are scattered over the sides. *Colours*—grayish-brown, tinged with red over the gill-covers and becoming yellow on the sides and dull white beneath. Fins gray, obliquely banded with darker.

Varieties.—Lütken confirms Peters' determination that examples from the east coast of Greenland are identical with those from the Baltic. Sir John

Richardson in the third edition of Yarrell, considered his *C. hexacornis* a variety of this species. Malmgren has observed that certain marine fishes as *Cottus quadricornis*, *Liparis barbatus* and a variety of the common herring, are found in the northern portion of the Baltic where that sea is least saline, whereas they appear to be entirely absent from its southern extremity where their presence might be anticipated had they obtained access from the North Sea. They are leaner and smaller in the Baltic than in the Arctic Ocean, and it is supposed that they are the remnants of the fauna of the Glacial Ocean. During the later portion of the glacial period most of Finland and the middle of Sweden were submerged, and the Baltic a gulf of the Glacial Ocean, being then closed in at the south. As the Scandinavian continent has become elevated, the Baltic has been cut off by land from the Arctic Ocean, whereas to the south it has obtained access into the North Sea, leaving it containing representatives of the former marine glacial fauna, not the products of immigration through the Sound. Thus inherited instinct induces these fish to seek a passage in the north, while, due to the alteration in the physical condition of the water in the Baltic, they are becoming a smaller and more miserable race than their relatives now living in the Arctic Ocean.

Habits.—Said to be active, a rapid swimmer, and eager after prey, to obtain which it conceals itself among stones or under sea-weed, from whence it darts on its victims. Lacépède states that it enters rivers.

Edward observes that he "never found this species but in the stomachs of fish; which led him to the conclusion that they generally inhabit deep water, or at least that they do not come so near the surface as the preceding species," *Cottus bubalis.*

Means of capture.—Yarrell observes that it is taken on the north-east coast by fishermen in winter when working nets with small meshes for sprats.

Breeding.—In winter. The ova are white.

Habitat.—This fish has been captured in latitude 82° 30′ north or within the limits of the Arctic Ocean, it is found in the Northern Ocean as far as Greenland, the west coast of Norway (absent, however, according to Collett), also in the northern portion of the Baltic and in the North Sea, as far south as the British Isles. Sir John Richardson found it very abundant at the mouth of the Coppermine River in British North America. In Britain it is said to be occasionally taken on the north-east coast. W. Thompson, February 7th, 1834, obtained one alive at Weymouth, which he transmitted to the Zoological Gardens. In Scotland, Edward observes its occurrence in Banffshire, but only from the stomachs of other fishes.

It has not been recorded from Ireland.

The example figured is from one in the British Museum, probably the same that has previously been employed by Yarrell and Couch. This fish attains to 12 or 13 inches in length.

Genus II.—Trigla, *Artedi.*

Hoplonotus, Guichenot.

Branchiostegals seven: pseudobranchiæ present. Head parallelopiped: with its superior and lateral surfaces bony. Villiform teeth in both jaws and usually on the vomer, but none on the palatines. Two dorsal fins, the first being of less extent than the second; three free filaments at the base of the pectoral fin. Air-bladder well developed, usually provided with lateral muscles, and sometimes partially divided internally by partitions. Pyloric appendages few or in moderate numbers.

Trigla was the Greek term for the Mullets, *Mullidæ;* Artedi united the two genera, and when they were again separated this name was appropriated to the gurnards.

These fishes are commonly known as *gurnards* or *gurnets* derived from an ancient British word signifying a firm or rugged structure, and as such applicable to their heads. *Cnùdan*, *cnodan*, or *crudan*, Gaelic, McAlpine. In France they have the epithet *Les Milans de mer.* Many species are able to produce sounds when beneath the water, from which has originated their Italian name *organo*, and their French designation *grondin.* The Romans termed them *lyres*, either due to their emitting sounds or else because their shapes bore a resemblance to the ancient "lyre."

The *air-bladder* in the British forms are exceedingly useful as a means of diagnosing species, as they vary exceedingly. Their structure is interesting, as they possess strong lateral muscles for the purpose of compression, thus diminishing their size, and assisting the fish to sink when desired. The thickness of the walls in some species, it has been suggested, may be for the purpose of resisting pressure when suddenly rising to the surface from great depths. M. Dufossé considers this organ as a generator of sound completely independent of the other organisms in the fish. If a gurnard is placed on its back and a long incision made in the abdominal walls and any viscera which obstruct view are drawn to one side, it is directed that the tip of the finger should be placed in contact with the air bladder and vibrations synchronous with and having the same intensity as the sound produced by the fish will be felt. Having isolated the organ as much as possible by delicate and rapid manipulation from the rest of the body, with the exception of the vessels and nerves with which it is supplied, a stethoscope provided at its mouth with a diaphragm of gold-beater's skin should be applied to its anterior part; then the nerves are to be severed first on one side then on the other, when the sounds will be found to decrease in intensity and finally entirely cease. He concluded that the intrinsic muscles by their vibration aided and intensified by the rest of the organs are the agents of the sounds produced; while other muscles can by their contraction alter the shape of the organ and thus modify the quality of the sounds emitted.

The rough granulations along the front edge of the first two dorsal spines are liable to vary in examples of the same species, in some being present and well developed, whereas in others they may be entirely wanting.

Habits.—Gurnards are rather voracious, mostly swimming near the bottom of the sea where they feed on crustacea or other small prey.

Their free pectoral filaments, which have a certain similarity to elongated fingers, are employed as feelers, used as a means of progression, or even for the purpose of drawing prey towards their mouth. Their large pectoral fins, although employed when balancing themselves in mid-water, are insufficient for the purpose of sustaining them in the air. They live for some time after their removal from the sea, and on being touched erect their dorsal spines, and at the same time emit certain sounds from which many local names have had their origin. These fishes, more especially *T. obscura*, have been reputed to emit light from the head, occasioning, according to Lacépède, their passage through the air to resemble the course of a shooting star. Couch observes that Risso believed this

faculty to be inherent in all the species of the Genus: Cuvier however denied that this power was possessed by all, and it has been surmised that such may be due to their conveying after them certain invertebrata that have luminous properties, and which occasion what the fishermen term "briming." They are said by some observers to swim in large companies, and when pursued by an enemy to spring out of the water.

Means of capture.—Gurnards, generally swimming near the bottom, are commonly taken by deep sea trawlers, but some species are likewise easily captured by hand-lines: a silvery slice from a sand launce, *Ammodytes*, forming an attractive bait. Long lines termed "bulters" with baited hooks are used for gurnard fishing.

Breeding.—They spawn about May or June, and Professor Sars has found their ova floating on the sea, rendering it almost certain that they may be included among those forms which do not deposit such on the ground.

As food.—Gurnards have always been held in fair estimation, but from the firmness of their flesh they are not so digestible as many other fishes as easily procurable: some forms, however, owing to their small size are deemed almost unfit for the table, while others are so inferior as to be considered worthless in certain districts. They are generally stuffed with forcemeat and subsequently baked: or their flesh is raised from the bones and dressed in fillets. They may likewise be gently boiled in salted water for half-an-hour, and then served up with a rich gravy or anchovy sauce, or with parsley and butter acidulated with Chili vinegar, lemon juice or caper pickle. A very ancient mode and still occasionally followed, is after having fried, to souce them in a sour sauce. However, in some places "souced gurnet" is employed as a term of contempt, as when Shakespere in King Henry IV, Act iv, Scene 2, makes Falstaff say, "If I be not ashamed of my soldiers, I am a soused gurnet."

Geographical distribution.—Coasts of Europe, being especially abundant in the Mediterranean. One species extending across the North Atlantic is found on the western shores of North America. To the south it passes round the west coast of Africa, and from the Atlantic to the Indian Ocean, apparently avoiding the east coast of Africa, the shores of India, and the contiguous islands.

Lepidotrigla, Günther, has been separated solely on account of the size of its scales* which are larger—a subdivision which is only partially approved of.

In Ireland the gray gurnard, *T. gurnardus*, is most numerous: next the sapphirine *T. hirundo:* then the red *T. cuculus:* 4th the streaked *T. lineata:* 5th the Piper *T. lyra* (Thompson).

1. Trigla lineata, Plate XXII.

Mullus imberbis, Rondel. x, c. 5, p. 295, c. fig.; Gesner, iv, p. 567; Aldrov. ii, c. 2, p. 131. *Milvus*, Jonston, De Pisc. lib. i, t. iii, c. 1. art. ii, p. 65, t. xvii, f. 12, &c. *Mullus imberbis*, l. c. p. 61, t. xviii, f. 4; Willughby, p. 278, t. S. i, f. 1; Ray, Syn. p. 87. *Cuculus lineatus*, Ray, Syn. p. 165, f. 11; Brünn. Pisc. Mass. p. 99. *Streaked gurnard*, Pennant, Brit. Zool. (Ed. 1) iii, p. 281, pl. lvii, (Ed. 2) iii, p. 377, pl. lxvi.

Trigla lineata, Gmel. Linn. p. 1345; Bloch, t. cccliv; Bl. Schn. p. 13; Donovan, Brit. Fish. i, pl. iv; Turton, Brit. Faun. p. 102; Cuv. and Val. iv, p. 34; Bonap. Ital. Pesci. iii, p. 58, c. fig; Scouler, Mag. Nat. Hist. vi, 1833, p. 530; Thompson, Pro. Zool. Soc. 1835, p. 79, and Nat. Hist. Ireland, iv, p. 72; Yarrell, Brit. Fishes (Ed. 1) i, p. 46, c. fig. (Ed. 2) i, p. 45, (Ed. 3) ii, p. 19; Jenyns, Brit. Vert. p. 339; Parnell, Fish. Frith of Forth, p. 15, t. xix; Swainson, Fish. ii, p. 262; Guichen. Explor. Alger. Poiss. p. 38; Flem. Brit. An. p. 215; Lowe, Pro. Zool. Soc. 1839, p. 77; Günther, Catal. ii, p. 200; Steind. Ich. Span. u. Port. 1867, p. 78; Cornish, Zool. 1878, p. 423.

Trigla lastoviza, Brün. Pisc. Mass. p. 99; Lacép. Poiss. iii, p. 349, 351.

Trigla Adriatica, Gmel. Linn. p. 1346; Bl. Schn. p. 15; Risso, Ich. Nice, p. 204, and Hist. Nat. iii, p. 394; Martens, Reise nach Venedig. ii, p. 430, t. xi; Flem. Brit. An. p. 215.

* Gill, Proc. Ac. Nat. Sc. Phil. 1864, p. 166.

Trigla pœciloptera, Thompson, P. Z. S. 1837, p. 61 (not Cuv. and Val.)
Streaked gurnard, Couch, Fish. Brit. Isles, ii, p. 25, pl. lxvii.

B. vii, D. 9-11 | 16-17, P. 10-11 + iii, V. 1/5, A. 16, C. 12, L. l. 66, Cœc. pyl. 10, Vert. 15/20.

Length of head $4\frac{1}{4}$ to $4\frac{3}{4}$, of caudal fin 5 to 6, height of body 5 to $5\frac{1}{2}$ in the total length. *Eye*—high up, almost touching dorsal profile, $1\frac{1}{2}$ to $1\frac{2}{3}$ diameters in the postorbital portion of the head, 2 diameters from the end of the snout, and 3/4 to 1 diameter apart. Interorbital space deeply concave: upper profile from eye to snout descends abruptly, in the adult almost vertically. Bones of the head with stellated ridges. Two or three distinct spines at the anterior-superior angle of the orbit, being the termination of ridges. Preorbital obtuse anteriorly, and granulated, most coarsely so in adults, when it may even be denticulated. Angle of preopercle usually with blunt, but sometimes with, sharp projections: supra-scapular roughened along its upper edge and terminating posteriorly in a sharp spine: scapular strongly ridged, likewise terminating in a strong spine. The posterior extremity of the maxilla does not extend to beneath the anterior edge of the eye. *Teeth*—fine in jaws, present or absent on vomer: palatines and tongue edentulous. *Fins*—second dorsal spine the longest, being equal to the distance between the hind edge of the eye and the end of the snout, its first and sometimes also its second (or even third) spine roughened anteriorly: rays of second dorsal divided at their outer extremities. Pectoral longer than the head, and reaching to above the 3rd to the 7th ray of the anal fin. Anal rays undivided. Ventral reaches the vent. Caudal emarginate. *Scales*—small. *Lateral-line*—with about 66 denticulated and serrated spines, equal to half the number of rows of scales above the lateral-line: the keeled row along the bases of the dorsal fins well developed, and consisting of about 25 scales. Running from the back down the sides are numerous raised lines or ridges which give it its characteristic appearance. *Cœcal appendages*—ten, those nearest the pylorus long and nearly twice the length of the outermost. *Air-bladder*—oval, rounded at both extremities with a large muscle, composed of transverse fibres going along its lateral borders. *Colours*—of a lake superiorly and on the sides, becoming white underneath. Narrow red vertical bands pass from the back down the sides. Dorsal and caudal fins reddish-brown, edged externally with red, and covered with numerous irregular spots and blotches. Pectoral of similar but darker colours, the spots almost forming transverse bands. Ventrals reddish-brown internally, with lighter red edges. Anal grayish-yellow, with a pink outer margin which has a dark base.

Names.—Streaked gurnard: lineated gurnard: French gurnard: rock gurnard: rabbit fish. Penhaiarn rhestrog, Welsh. *Le Rouget Camard*, French.

Habits.—Although this fish usually keeps near the bottom, it is sometimes captured in nets which do not descend nearly so low, while it has been occasionally observed springing out of the sea. It appears to restrict itself to certain localities probably due to the food which may be present. Its migrations are effected, according to Couch, at higher elevations than among the other forms of the genus: he obtained one from a net that floated over 30 fathoms. Once at Polperro, not its usual resort, a fish was observed springing out of the water in an unusual manner, and on being captured proved to be a streaked gurnard. It eats crustacea and small fish, while pebbles and vegetable substances have been found in its stomach. Thompson detected in one what had "the appearance of vegetable food and a young sole about 3 inches in length, crab-like crustacea, 15 full-grown specimens of shrimp-like crustacea and 3 small brachyurous crustacea" as well as other crabs.

Means of capture.—Is generally taken in trammels set for surmullets, or with the trawl, and but rarely (Mr. Cornish, l. c. says never) by means of baits. In the aquarium it takes pieces of mussel or shrimps, as well as any other of the genus, and becomes equally tame, therefore one would imagine that it must sometimes be caught by baits.

Breeding.—Eggs small and numerous.

As food.—It is said to equal *Trigla pini.*

Habitat.—From the British coast to the Canary Islands, also through the Mediterranean and Adriatic.

In Britain it appears to have been first observed by Mr. Jago in Cornwall, and is most numerous along the south coast, becoming rarer towards the north, only stragglers having been observed in Scotland, one having been procured near Ayr, and a second in October, 1844, at Glasgow: while on the west coast of England it is said to be locally rare. Mr. Cornish remarked in May, 1866, that he had taken two examples at Penzance, being 29 since 1858 (Zoologist, 1866, p. 311).

In Ireland, Thompson remarks that a few are taken every year in the county of Down, chiefly at Killough, and one by Ball at Youghal: the most usual time being the last six and first three months in the year.

It attains to at least 14 inches in length.

2. Trigla cuculus, Plate XXIII.

Lyra, Jonston, De Pisc. lib. i, tit. iii, c. 1, art. 3, pp. 66, t. xxiv, f. 4. *Trigla*, Artedi, Gen. 45, syn. 74. *Cuculus Aldrovandus*, Ray, p. 89; Rutty, N. H. Co. Dublin, 1772, p. 367. *Red gurnard*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 278, pl. 57, (Ed. 1812) iii, p. 373, pl. 66.

Trigla cuculus, Linn. Syst. Nat. p. 497 and Mus. Ad. Fried. ii, p. 93; Shaw, Zool. iv, p. 620, pl. 90; Cuv. and Val. iv, p. 26; Dekay, N. Y. Fauna, p. 43, pl. lxx, f. 225; Bonap. Icones Ital. Pesci, iii, p. 58, c. fig; Fleming, p. 215; Yarrell, Brit. Fish. (Ed. 1) i, p. 34, c. fig. (Ed. 2) i, p. 38, (Ed. 3) ii, p. 10; Parnell, Fishes Frith of Forth, p. 14, t. xviii; Swainson, Fishes, ii, p. 262; White, Cat. Brit. Fish. p. 2; Steind. Ich. Span. u. Port. 1867, p. 78; Malm, Œfv. Sv. Akad. 1870, p. 825; Collett, Norges Fiske, p. 37.

Trigla pini, Bloch, t. ccclv; Bl. Schn. p. 14; Lacép. iii, p. 356; Risso, Ich. Nice, p. 206; Jenyns, Brit. Vert. p. 338; Johnston, Berwick. Nat. Club, 1838, i, p. 170; Thompson, Nat. Hist. Ireland, iv, p. 71; Swainson, ii, p. 262; Günther, Catal. ii, p. 199; McIntosh, Fish. St. Andrew's, p. 172.

Trigla lineata, Montague, Wern. Mem. ii, p. 460 (not Gmel. Linn.); Flem. Brit. An. 215.

Polynemus tridigitatus, Mitchell, Trans. Lit. and Phil. Soc. New York, i, p. 449.

Pine-leaved gurnard, Shaw, Nat. Misc. xxii, pl. 954.

Elleck, Couch, Fishes Brit. Isles, ii, p. 19, pl. lxiv.

B. vii, D. 8-9/18, P. 10+iii, V. 1/5, A. 16-17, C. 13, L. l. 73-76, Cœc. pyl. 8, Vert. 15/21-22.

Length of head 4 to $4\frac{1}{2}$, of caudal fin $5\frac{1}{3}$, height of body 6 in the total length. *Eye*—$1\frac{1}{4}$ diameters in the postorbital portion of the head, $1\frac{1}{4}$ diameters from end of snout, and $\frac{1}{2}$ a diameter apart. Interorbital space concave. Upper profile from eye to snout descends rather abruptly and is slightly concave. The form of the snout appears to be liable to vary, in one male example it is broader and more strongly armed than in any other of my specimens. Bones of the head with stellated ridges. Two or three small spines at the anterior-superior angle of the orbit. Preorbital with short denticulations anteriorly. Opercle with a well-developed spine. Angle of preopercle with a spinate termination below which are two smaller ones. Supra-scapular roughened along its upper edge and ending in a short but sharp spine: coracoid likewise ending in a spine. The posterior extremity of the maxilla reaches to beneath the front of the eye. *Teeth*—fine ones present in jaws, and on the vomer, none on the palatine bones or tongue. *Fins*—second dorsal spine the highest, being more than 2/3 the length of the head, the first spine is tuberculated anteriorly. Pectoral about as long as the head and reaching to above the third or fourth anal ray. Caudal emarginate. *Scales*—small, those on the lateral-line unarmed, but forming lineated plates, very much deeper than wide, occasioning the lateral-line to appear as if crossed by about 72 vertical folds of skin. Ridge along the base of the dorsal fin having about 27 spines. *Air-bladder*—with two short and rounded

prolongations anteriorly and a muscle along either side. *Colours*—rosy. Irides golden orange.

Varieties.—Thompson refers to having obtained one in March, 1838, "D. 8/18, A. 16. The hinder half of this specimen was grayish, like *T. hirundo* (of which a small one was taken with it), the anterior half, including the head, a mixture of gray and scarlet. It was a female, the ova half the size of small clover seed." Couch records a variety of unusual size, having the back, head, and sides covered thickly with golden spots about the size of a large pea.

Names.—The specific term given to this species by Bloch was *Pini*, as he considered the short straight lines crossing the lateral-line bore somewhat of a resemblance to the *acicular* leaves of the pine. *Red* or *Cuckoo gurnard: elleck: soldier: pine-leaved gurnard. Penhaiarn coch*, Welsh. *Le Grondin rouge*, and *Rouget commun*, French.

Habits.—Keeps near the bottom in moderately deep water. Feeds on small fishes, molluscs and crustacea. In Belfast it is said to be most abundant early in the spring and late in the autumn.

Mode of capture.—A voracious species that takes a bait freely, but is mostly captured in the trawl.

Breeding.—Couch observes that he found them with well-developed ova both in January and also in April and June. Young about 1½ inches in length have been taken in August.

As food.—Large quantities are consumed in England, but in Scotland it does not appear to be held in any estimation. In France it is taken in quantities for the last four months of the year, and is much esteemed because of its firm flesh and good taste; it is even preserved in olive-oil.

Habitat.—Scandinavia and down the west coast of Europe to the Mediterranean, and is also recorded from New York and the American shores of the North Atlantic Ocean.

Common along the English coast, especially on the south and west, at all seasons, and is likewise taken in Scotland: is pretty common in Banffshire (Edward) and occasionally observed in St. Andrew's Bay (McIntosh): two were taken in the Orkneys in the winter of 1850-51 (W. Baikie). It has been recorded from Wick, the Moray Frith, and occasionally at Lossiemouth.

In Ireland it is common from Waterford on the south up the east coast to Londonderry.

It attains to at least 18 inches in length.

3. **Trigla hirundo,** Plate XXIV.

Corax, Rondel. x, c. 7, p. 396, c. fig.; Gesner, Aquat. iv, p. 299; Aldrov. Pisc. ii, c. 57; Willughby, Ich. iv, p. 280, t. P. 4. *Corvus*, Salv. Hist. Aquat. p. 194, f. 71. *Hirundo*, Aldrov. Pisc. ii, c. iii, p. 133; Jonston, lib. i, t. iii, c. 1, art. 2, p. 64, t. xvii, f. 8, 9; Ray, p. 88; Willugh. p. 280; Ray, p. 88. *Lucerna Venetorum*, Willugh. iv, p. 281; Ray, p. 88; Gronov. Zooph. p. 84, No. 284. *Sapphirine gurnard*, Pennant, Brit. Zool. (Ed. 1), iii. p. 280, pl. lvi (Ed. 2), iii, p. 376, pl. lxviii.

Trigla cuculus, Brünn. Pisc. Mass. p. 77; Gronov. ed. Gray, p. 105.

Trigla hirundo, Linn. Syst. i, p. 497; Bloch, Ich. p. 518, t. lx; Bonat. Ich. p. 146, pl. lx, f. 238; Gmel. Linn. p. 1344; Bl. Schn. p. 15; Donovan, Brit. Fish. i, pl. i; Lacép. iii, p. 353; Shaw, Zool. iv, pt. 2, p. 621; Turton, p. 102; Risso, Ich. Nice, p. 205; Cuv. and Val. iv, p. 40; Flem. Brit. An. p. 214; Thompson, Pro. Zool. Soc. 1835, p. 79, and Nat. Hist. Ireland, iv, p. 73; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Parnell, Fishes Frith of Forth, p. 16, pl. xx; Yarrell, Brit. Fishes (Ed. 1), i, p. 41, c. fig. (Ed. 2) i, p. 47, (Ed. 3) ii, p. 21; Jenyns, Brit. Vert. p. 340; Swainson, ii, p. 262; Guichen. Explor. Alger. Poissons, p. 39; White, Catal. Brit. Fish. p. 3; Günther, Catal. ii, p. 202; Schlegel, De Dieren van Nederland, p. 43, pl. iv, f. 2; Moreau, Compt. Rend. 1864, ii, p. 436; Steind. Ich. Span. u. Port. 1867, p. 81; Collett, Norges Fiske, p. 37; McIntosh, Fish. St. Andrew's, p. 172.

Trigla lævis, Montagu, Mem. Wern. Soc. ii, pt. 2, p. 455; Flem. Brit. Anim. p. 214, sp. 148; Swainson, Fishes, ii, p. 420; Embleton, Berwick. Nat. Field Club, 1831, p. 22.

Trigla corvus, Risso, Hist. Nat. iii, p, 398.

Trigla corax, Bonap. Faun. Ital. Pesci, t. f. 1.

Trigla pœciloptera (*Young*), Cuv. and Val. iv, p. 47; Yarrell, Brit. Fishes (Ed. 2) i, p. 49, c. fig. (Ed. 3) ii, p. 24; Swainson, ii, p. 262; Thompson, Proc. Zool. Soc. 1837, p. 61, and Nat. Hist. Ireland, iv, p. 79; Demid. Voy. Russ. Mérid. iii, p. 375; Guichen. Explor. Alger. Poiss. p. 39; White, Catal. Brit. Fish. p. 3; Walker, Zool. 1859, p. 6540; Günther, Catal. ii, p. 203; Couch, Brit. Fish. ii, p. 36, pl. lxx, f. 2.

Tubfish, Couch, Fish. Brit. Isles, ii, p. 21, pl. lxv.

B. vii, D. 9/16-17. P. 10 + iii, V. 1/5. A. 15-16, C. 12. Cœc. pyl. 10, Vert. 14-15/19.

Length of head $3\frac{2}{3}$ to 4, of caudal fin $4\frac{3}{4}$ to $5\frac{1}{3}$, height of body 6 to $6\frac{1}{3}$ in the total length. *Eye*—$1\frac{1}{4}$ to $1\frac{1}{2}$ diameters in the postorbital portion of the head, 2 diameters from the end of the snout, and 1 diameter apart. Interorbital space deeply concave. Upper profile from eyes to snout, with a slight descent. Bones of the head with stellated ridges, which are least developed between the eyes. Several spinate denticulations at the anterior-superior angle of the orbit. Preorbital granulated anteriorly, even serrated in some examples and in the young: angle of preopercle acute, and in the young there are two sharp spines. Supra-scapular roughened, ending posteriorly in a short and sharp spine. Coracoid with a roughened ridge passing across it and ending in a spine: all these spines are more developed in the young than in the adult, and they differ in their extent in adult examples. In the young a strong ridge ending in a spine passes across the opercle: while the occiput has two spines posteriorly. The posterior extremity of the maxilla almost reaches to beneath the front edge of the eye. *Teeth*—fine ones in the jaws and on the vomer: none on the palatines or tongue. *Fins*—first dorsal spines almost or quite smooth anteriorly, the second the longest and equal to the length of the snout: rays of the second dorsal scarcely more than half as high as the first dorsal, and some are divided at their extremities. Pectoral longer than the head (this is subject to variation) and reaching to above the seventh anal ray. Caudal emarginate. *Scales*—small, nearly 200 irregular rows descend towards the lateral-line, the scales of which are unarmed. From 25 to 27 spinate plates along the base of the dorsal fins. *Air-bladder*—large, trilobed all of equal length in the adult, anteriorly they communicate freely with one another. Anteriorly the air-vessel is produced into two short horns: the outer wall is very muscular. *In the young*, the lateral lobes are very short but they gradually increase in length with the age of the fish. According to M. Moreau (Comptes Rendus, 1864, t. lix, p. 436), the air-bladder is furnished with thick and strong muscles of the striped or voluntary kind. Two large nerves pass to it from the upper part of the spinal cord close to the first pair of dorsal nerves and below the pneumogastric. The mucous membrane which lines the internal surface of the air-bladder forms a fold or diaphragm which subdivides this cavity into two secondary chambers, communicating by an aperture in this partition, which has some function analagous to that of the pupil of the eye: as under the microscope it is seen to be provided with sphincter-like muscular fibres disposed concentrically to the opening, while others radially arranged pass at a tangent from them. Both sets of muscular fibres are smooth and presumably of the involuntary variety. In August, 1863, a section of the spinal cord above the dorsal region was made in one of these fish while still living, the abdomen was opened and a feeble galvanic current passed to the nerves proceeding to the air-bladder. Sounds similar to those emitted during life were immediately produced audible to persons standing at some distance. A current was next applied to the muscle of the air-bladder but without any result. Next a window was cut in the lower portion of the air-bladder so as to expose the diaphragm, and galvanism being applied, it was seen to be thrown into a state of vibration but no

sounds were produced, due perhaps to an escape of gas from the chamber. *Cœcal appendages*—ten, or eight according to Cuvier and Valenciennes, so they may vary, they are rather long. *Colours*—brownish-red. Pectoral fin reddish externally with bluish margins, blue internally with numerous blackish blotches, taking the form of transverse bands. In the *young* the back is reddish-brown, abdomen silvery, the sides being glossed with golden. Dorsal fins reddish, the first being black-tipped, and the second violet with a dark basal band, and also dark along its upper half. Caudal purplish. Pectoral violet externally, having irregular narrow and dark transverse bands: on the posterior half or two-thirds of its inner side exists a large oval black or very dark-blue blotch, on which are scattered small milk-white or light-blue spots, this mark generally disappears in the adult, but traces are frequently perceptible.

Names.—Aldrovandus adopted the term *hirundo* for this fish, perhaps he traced a resemblance between the spots on its pectoral fins to the white spots on each of the tail feathers of the common swallow. It is known as the *Sapphirine gurnard*, *tub-fish*, or *tubbot*: *sea crow*: *red tubs*: *smooth sides*. *Yfgyfarnog y mor*, Welsh. In Belfast it is commonly called the *gray gurnard*, and there the *T. gurnardus* is called *knowl*. *L'Hirondelle de mer*, *Le Perlon*, and *Rouget grondin*, French. *De groote Poon*, Dutch.

By a slip of the pen Linnæus described *Trigla hirundo* as having "linea laterali aculeata," which caused Pennant, Fleming, and others to describe "the side-line as rough," and doubtless also misled Montague into the belief that his fish without a rough lateral-line was a new species, so he named it *T. lævis*.

Thompson's example of "the little gurnard" from Youghal, in Ireland, with D. 10/15 and "lateral-line spinous," cannot have been *T. pœciloptera*, but perhaps the young of *T. lineata*. Steindachner, in 1867, observed that *T. pœciloptera*, C. V., is identical with *T. corax*, Bonap. and *T. capensis*, C. V., and the young of *T. hirundo*, which was confirmed by Professor Lütken in 1876.

Habits.—This species usually remains near the bottom in rather deep water, but occasionally rises to the surface. It lives on crustacea, molluscs, and such small fish as it can catch. The young generally lie at the bottom in shallow water, with their pectoral fins widely expanded, the blue colours of which, and the dark blotch covered with white spots, give them the appearance of gorgeous butterflies, as of course the inner or coloured side becomes that portion which is most exposed to view. It seems to be very fond of shrimps, and Lloyd remarks that when in an aquarium any have fallen to the bottom, and got under the sand, it has been observed to use the free rays of its pectoral fins to disturb them by feeling, hooking, and poking above them (Hardw. Science Gossip, 1865, p. 236). Thompson found a sordid dragonet inside one; and Couch observed a pecten as large as half a crown; and small solens or razor-shells have been obtained from their stomachs.

Means of capture.—Usually by the trawl along with flat fish, but they also take a bait and are occasionally captured in salmon nets in the autumn.

Breeding.—This fish appears to breed during the first six months of the year. Couch found them with mature ova in December and February. Risso observed that they deposited eggs in the spring, and Couch found the roe enlarged both at Christmas and also in May and July. Walker, when trawling in the Dee for shrimps in March, 1859, frequently took the young (Zoologist, p. 6540).

As food.—This species is nearly equal to the best sorts of gurnards, and is often preferred in consequence of attaining to a large size; its flesh, however, is rather dry, and requires sauce. It is salted in the north of Europe, and thus used in Denmark for ships' provisions.

Habitat.—Norway, the western coast of Europe, round Great Britain and Ireland, and through the Mediterranean and Adriatic.

Is common round the British coast, but scarcely so abundant as *T. cuculus*. Yarrell says it is the most abundant, while it decreases in number towards the north. It has been recorded at Lossiemouth in January, 1841, and October, 1845, by Gordon (Zoologist, p. 3458), while Edward remarks that it is pretty common

in Banffshire, where the largest are obtained towards the end of autumn. In the spring of 1840 one of the young was taken from the stomach of a great northern diver. Thompson likewise remarks that he has seen this species in autumn captured in salmon nets at Ballantrae, in Ayrshire, and on different parts of the coast in the country.

In Ireland, Thompson observes that this fish is found round the coast; and at Youghal it is termed *tubs*. Moore mentions it in Kerry. It is brought to the Belfast market chiefly during the spring and autumn, but said to be in the best condition in May.

It attains, according to Thompson, to at least 14 lb. weight, and 2 feet or more in length.

4. Trigla gurnardus, Plate XXV.

Coccyx alter, Belon. i, p. 207; Jonston, De Pisc. lib. i, t. iii, c. 1, art. 2, p. 65, t. xvii, f. 11. *Cornatus s. gurnardus griseus*, Willughby, iv, c. 7, p. 279, t. S. 2, f. 1; Ray, p. 88. *Trigla*, sp. 8; Artedi, Genera, p. 46; Gronov. Mus. Ich. p. 44, and Zooph. p. 84, no. 283. *Milvus*, Rondel. x, c. 8, p. 297, c. fig; Aldrov. ii, c. 58, p. 279. *Corystion*, Klein, Mss. iv, pl. xiv, f. 2. *Gurnardus griseus seu Cuculus griseus*, Rutty, N. Hist. Co. Dublin, 1772, i, p. 367. *Gray gurnard*, Pennant, (Ed. 1) iii, p. 276, pl. liv, (Ed. 2) iii, 371, pl. lxv; Low, Faun. Orcad. p. 229.

Trigla gurnardus, Linn. Syst. Nat. i, p. 497; Bonaterre, Ency. Ich. p. 145, pl. lx, f. 236; Gmel. Linn. i, p. 1342; Bloch, t. lviii; Bl. Schn. p. 14; Donovan, ii, pl. xxx; Lacép. Poiss. iii, p. 358; Shaw, Zool. iv, pt. 2, p. 619, pl. xc; Turton, p. 102; Risso, Ich. Nice, p. 207; Faber, Fische Islands, p. 124; Cuv. and Val. iv, p. 62; Bonap. Fauna Ital. Pesci, iii, p. 102, c. fig.; Flem. Brit. An. p. 215; Yarrell, Brit. Fishes (Ed. 1) i, p. 48, c. fig. (Ed. 2) i, p. 53, (Ed. 3) ii, p. 28; Templeton, Mag. N. Hist. (2) i, 1837, p. 409; Jenyns, Brit. Vert. p. 342; Swainson, Fishes, ii, p. 262; Johnston, Berwick. Nat. Field Club, 1838, i, p. 170; Parnell, Fishes Frith of Forth, p. 18, pl. xxii; White, Catal. p. 4; Thompson, Nat. Hist. Ireland. iv, p. 74; Günther, Catal. ii, p. 205; Schlegel, De Dieren van Ned. p. 45, pl. iv, f. 1; Malm, Œfv. Sv. Akad. 1870, p. 829; Collett, Norges Fiske, p. 37; McIntosh, Fish. St. Andrew's, p. 172.

Trigla cuculus, Bloch, Ich. p. 516, t. lix; Gmel. Linn. p. 1343; Bl. Schn. p. 14; Bonaterre, Ency. p. 146, pl. lx, f. 237; Turton, p. 102; Risso, Ich. Nice, p. 208; Mont. Wern. Mem. ii, p. 457; Flem. Brit. An. p. 215; Cuv. and Val. iv, p. 67; Jenyns, Brit. Vert. p. 343; Günther, Catal. ii, p. 207; Thomp. Pro. Zoo. Soc. 1837, p. 57 and Nat. Hist. Ireland, iv, p. 74.

Trigla milvus, Lacép. Poiss. iii, p. 340, 362; Risso, Hist. Nat. iii, p. 395; Cuv. and Val. iv, p. 67; Bonap. Faun. Ital. Pesc. iii, p. 52, c. fig.

Trigla Blochii, Yarrell, Brit. Fish. (Ed. 1) i, p. 50, c. fig. (Ed. 2) i, p. 56, (Ed. 3) ii, p. 32; Parnell, Fish. Frith of Forth, p. 21, t. xxiii; White, Catal. p. 4; Swainson, ii, p. 262.

Trigla gurnardi, var. Parn. Wern. Mem. vii, p. 182.

Trigla aspera, Gronov. ed. Gray. p. 105.

Gurnard, Couch, Fish. Brit. Isles, ii, p. 27, pl. lxviii.

Bloch's gurnard, Couch, l. c. ii, p. 29, pl. lxix.

B. vii, D. 8-9/19, P. 10, V. 1/5, A. 18-19, C. 15, L. l. 73-76, Cœc. pyl. 7-9, Vert. 14/24.

Length of head $3\frac{2}{3}$ to $3\frac{2}{5}$, of caudal fin 6 to $6\frac{1}{2}$, height of body 6 in the total length. *Eyes*—high up, situated nearer to the posterior than to the anterior end of the head, in adults being about $1\frac{2}{3}$ diameter from the posterior end of the head and two from the end of the snout. Interorbital space slightly concave and a little less in extent than the diameter of the eye. Snout elongated, with its upper profile nearly straight, being most obtuse in the young. Head with stellated ridges the lines forming which are mostly tubercular and not very prominent: upper surface of head tuberculated. The anterior extremity of the preorbital denticulated, spinate in the young: two or three small supraorbital

spines: angle of the preopercle with two or three denticulations: opercular spine strong, and larger than that at the shoulder, while the opercle above the spine is deeply emarginated so as to cause it to have a pointed prominence: coracoid with a very strong spine. Two spines at occiput in the young. *Teeth*—villiform ones on the jaws and vomer, none on the palatines or tongue. *Fins*—dorsal spines of moderate strength, the second being rather the longest, equalling the distance between the anterior end of the snout and the posterior margin of the eye, they are roughened on their anterior edge. Pectoral does not quite reach the commencement of the anal and is rather shorter than the ventral. Caudal emarginate. *Scales*—small. *Lateral-line*—armed with about 74 spinous points which are most distinct in the immature. Stomach and cœcal appendages similar to *T. hirundo*. *Air-bladder*—notched at its anterior extremity and ending in two obtuse rounded points. *Colours*—these vary widely, in some there are no white spots, the upper half of the body being of a slaty-gray, conjoined with which a black blotch usually exists on the first dorsal fin (*T. Blochii*): this dorsal blotch is, as a rule, present in all specimens, although in some it is faint or merges into the colour of the remainder of the fin, while it usually becomes lost in examples kept long in spirit: occasionally the dorsal blotch instead of being round is semicircular. The white spots on the sides may run into narrow and sinuous lines; or else there may be a dark net-work surrounding light spaces. The dorsal blotch is sometimes encircled by a light ring.

Varieties.—*Trigla Blochii* having a black spot on the first dorsal fin and no white spots on the body, has been considered a distinct species. Parnell showed it to be a variety, and Thompson records instances of both it and *T. gurnardus*, likewise of the intermediate forms, observing that without having traced the changes from youth upwards, one could hardly believe in the modifications which really take place. As this fish increases in size the granulations extend over the rays of the first dorsal fin and are not confined to the three or four anterior ones only.

Couch believed that he had twice obtained *Trigla Blochii* or else a species nearly allied to it, and of which he gives a figure, plate lxix. Like *T. gurnardus* it is said to have the lateral-line rough, the roughness formed of small obtuse points.

Yarrell seems never to have obtained Bloch's gurnard but named it from Bloch's apparently erroneous figure; his illustration shows the first spine of the dorsal fin the highest, but in his second edition it is reduced to lower than the second spine and it is similarly represented in the third edition. I have received from Professor Giglioli of the Florence Museum an Italian example of this fish which does not differ from the British variety.

Names.—*Gray gurnard: hardhead.* In Scotland, *crooner* or *croonach* (perhaps from *croon* "to croak"): *gowdie*, *girnat* and *croonyal*, in Moray Frith according to Gordon (Zoologist, p. 3458). *Knoud* or *nowd*, Ireland. *Penhaiam Uwyd* and *penhaiernyn*, Welsh. *Le grondin* or *grondin*, French. *De klein poon* and *knoshaen*, Dutch.

Dr. Johnston observes that *crooner* may have reference either to the hard and and somewhat peculiarly shaped head of the fish, from *croon* the top of the head; or it may be derived from the verb *croon*—viz., to hum an air in an unmusical tone, because of the peculiar noise which the fish sometimes utters on being taken from the water. Thompson describes the sounds emitted by this fish as a kind of snoring noise.

Habits.—Gregarious, and said to be the least sensible to variations of temperature of the whole of the genus. At the Westminster Aquarium they are found to be the most difficult to keep alive; perhaps they are unable to bear confinement. Pennant, Couch, and others, remark upon their being fond of sporting near the surface to which they mount with the apparent object of enjoyment, as when there they move along at a slow space, rising and sinking in the water for a short distance and uttering short grunts as if of satisfaction. At other times they appear asleep, showing no signs of animation until an attempt is made to take hold of them.

Means of capture.—They readily take a bait and are generally secured in deep water. Pennant observes that they will bite at a piece of red rag. Thompson, that they are mostly captured in Ireland during the summer and autumn; the baits employed usually being "sand eels," young herrings, fat of meat, or a slice of one of their own kind. Low observes that they are taken by sailors as they approach the Orkneys by hanging over the stern of their vessel during a brisk breeze a hook and baited line, which this fish, being a quick swimmer, takes. When they are hauled on board they make a sort of croaking plaintive noise something like an angry person growling to himself, and this lasts for some time.

Breeding.—Probably twice a year, in January and December, also in June and July. The roe is deposited at some distance from the shore, and Sars has observed that the eggs float.*

As food.—Said to be good, and with firm flesh but very inferior to the *red gurnard*, partly from their lesser size: off Banffshire, Edward observes, they are not much esteemed. Thompson likewise remarks that in Ireland they are not in much favour for the table with those who can afford a choice, consequently they form a cheap food for the poor.

Habitat.—Baltic and west coast of Europe from Norway southwards, also the Mediterranean and Adriatic.

It is an abundant British species extending northwards to the Orkneys and Shetland Isles. It is very common on the west coast of Scotland and frequently taken in the Moray Frith.

It is numerous all round Ireland, and Thompson observes that along the northern coast they are frequently seen in vast shoals on the surface during the summer season and are captured in great numbers. Wherever the red gurnard is found, there the gray form is also common. In the month of June it is said to appear in Donegal Bay in enormous shoals when it is eagerly sought for, some eaten fresh, the remainder salted and laid up in store.

It attains to $2\frac{1}{2}$ feet in length according to Pennant.

5. **Trigla lyra,** Plate XXVI.

Lyra, Rondel. x, c. 9, p. 298, c. fig.; Gesner, iv, p. 516; Aldrov. ii, c. 7, p. 146; Willughby, iv, pp. 282, 283, t. S. 1, f. 4, and S. 2, f. 2; Ray, p. 89; Duham. Pêches, sect. v, t. viii, f. 1; Salv. p. 190, f. 70; Jonston, De Pisc. lib. i, t. iii, c. 1, art. 2, p. 65, t. xvii, f. 10. *Trigla*, Artedi, sp. 9, Genera, p. 46, syn. 74. *Piper*, Pennant, Brit. Zool. (Ed. 1) iii, p. 279, pl. lv (Ed. 2) iii, p. 374, pl. lxvii.

Trigla lyra, Linn. Sys. i, p. 496; Gmel. Linn. p. 1342; Lacèp. iii, p. 345; Bonn. Ency. Ich. p. 145, pl. lx, f. 235; Bloch, t. cccl; Bl. Schn. p. 14; Turton, Brit. Faun. p. 102; Donovan, Brit. Fish. v, pl. cxviii; Shaw, Zool. iv, p. 620; Risso, Ich. Nice. p. 203, and Hist. Nat. iii, p. 393; Cuv. and Val. iv, p. 55; Flem. Brit. Anim. p. 215; Bonap. Fauna Ital. Pesci, iii, p. 32, c. fig.; Scouler, Mag. Nat. Hist. vi, 1833, p. 529; Yarrell, Brit. Fishes, (Ed. 1) i, p. 44, c. fig. (Ed. 2) i, p. 51, (Ed. 3) ii, p. 26; Jenyns, Brit. Vert. p. 341; Swainson, ii, p. 262; Thompson, Nat. Hist. Ireland, iv, p. 74; Guichen. Explor. Algér. Poiss. p. 39; White, Catal. Brit. Fish. p. 4; Günther, Catal. ii, p. 208; Steind. Ich. Span. u. Port. 1867, p. 85.

Piper, Couch, Fishes Brit. Isles, ii, p. 23, pl. lxvi.

B. vii, D. 9-10/16-17, P. 10 + iii, V. 1/5, A. 16, C. 12. Cœc. pyl. 6, Vert. 13/20.

Length of head $3\frac{1}{4}$ to $3\frac{2}{3}$, of caudal fin 5 to 6, height of body $4\frac{1}{4}$ to $5\frac{1}{2}$ in the total length. *Eye*—1 to $1\frac{1}{2}$ diameters in the postorbital portion of the head, 2 diameters from the end of the snout in adults, $\frac{1}{2}$ to 1 diameter apart. Anterior portion of the body very much broader than the posterior. Interorbital space slightly concave. Upper profile, from eye to snout abrupt and concave. Bones of the head with rough stellated ridges. A spine at the anterior-superior angle of the orbit. A roughened ridge crosses the preopercle and ends at its angle

* Ann. and May, Nat. Hist. 1868 (4), i, p. 390.

in a short spine. Preorbital elongated anteriorly and ending in a broad triangular plate, armed in front with several denticulations. Opercle with a strong spine. A serrated ridge passes from the eye to the supra-scapular, which ends in a large and sharp spine. The coracoid also terminates in a very long spine equal to almost half the length of the head. The posterior extremity of the maxilla does not reach to beneath the front edge of the eye. *Teeth*—fine ones in the jaws and vomer, none on the palatines or tongue. *Fins*—dorsal spines strong, the third the longest and equalling half the length of the head: the first spine roughened anteriorly. Pectoral reaching to above the seventh or eighth anal ray. Caudal emarginate. *Scales*—much more distinct in large examples than in some other species of the genus. *Lateral-line*—unarmed. 25 to 27 strong, spinate elevations along the base of the dorsal fin. *Cœcal appendages*—six. *Air-bladder*—oval, smallest and pointed anteriorly, enlarged posteriorly but without any divisions. *Colour*—of a bright red, becoming lighter on the sides and white beneath. Fins red.

Names.—The piper: in Scotland according to Sibbald, *crowner* and *sea-hen*. *Pibydd*, Welsh. *La Lyre*, French.

Habits.—A wandering fish which Couch observed is sometimes common and at others somewhat rare. When captured it emits a hissing sound by expelling air through its gills. The stomach of one opened was full of *Ophiuroidea*.

Means of capture.—Usually taken with the trawl.

As food.—Is considered in some places as excellent for the table, even the epicure Quin bearing testimony to its merits.

Habitat.—From the British Isles and west coast of Europe through the Mediterranean.

Common on the south-west and western coasts of Great Britain, unless during the winter months, but being a great wanderer it is often rare at one season, numerous in another. It is little known to the north of England and not recorded from the north of Scotland, although Scouler observes that it is not rare in Glasgow, where examples sometimes weigh 7 lb.

In Ireland it is found on the south and south-west coasts according to Thompson who considered Templeton's fish from the north of Ireland to be *T. cuculus*. Moore has reported it from Kerry. The Earl of Ducie in Ballinskellig Bay, obtained in 1876 four, in 1877 one, and in 1879 nine.

Pennant observes that it grows to 2 feet in length, and Jenyns that it attains a weight of nearly 7 lb.

6. Trigla obscura, Plate XXVII.

Cuculus, Rondel. Pisc. Mar. lib. x, c. 2, p. 287, c. fig.; Gesner, Aquat. iv, p. 305 and 1598, f. 17, c. fig.; Aldrov. ii, c. 4, p. 138.

Trigla obscura, Linn. Mus. Ad. Frid. ii, p. 94; Bl. Schn. p. 16; Bonap. Faun. Ital. Pesci, iii, p. 102, c. fig.; Steind. Ich. Span. u. Port. 1867, p. 87; Günther, Catal. ii, p. 210.

Trigla lucerna, Brünn. Pisc. Mass. p. 76; Risso, Ich. Nice, p. 209; Cuv. and Val. iv, p. 72, pl. lxxii; Yarrell, Brit. Fish. (Ed. 2) i, p. 63, c. fig. (Ed. 3) ii, p. 39; Parnell, Mag. Zool. and Bot. i, p. 526 and Fishes Firth of Forth, p. 23, pl. xxiv; Guichen. Exp. Algér. Poiss. p. 40; White, Catal. Brit. Fish. p. 5 (not *Trigla lucerna* Linn.).

Trigla cuculus, Risso, Eur. Mérid. iii, p. 394.

Trigla filaris, Otto, Conspect. pp. 7 and 8.

Lanthorn gurnard, Couch, Fish. British Isles, ii, p. 33, pl. lxx.

B. vii, D. 10 | 17—18, P. 10+iii, V. 1/5, A. 17, C. 12, L. l. 70, Cœc. pyl. 8, Vert. 12/23.

Length of head $4\frac{1}{2}$, of caudal fin $5\frac{2}{3}$, height of body 7 in the total length. *Eye*—diameter $1\frac{1}{4}$ in the postorbital portion of the head, 2/3 of a diameter apart. Interorbital space slightly concave. Upper profile, from eye to snout, descends abruptly, and is slightly convex. Bones of the head with roughened stellated ridges. Several small spines at the anterior-superior angle of the orbit. Preor-

bital with a strong spine anteriorly, and sometimes followed by a few smaller ones. Opercular spine not well developed. Angle of preopercle with two small spines. Supra-scapular and coracoid both ending in small spines. *Teeth*—fine ones in jaws and vomer, none on the palatines. *Fins*—second dorsal spine very elongated, equalling about 1/3 of the entire length of the fish. Pectoral about as long as the head and reaching to above the third anal ray. Caudal forked in its last third. *Scales*—small. *Lateral-line*—consisting of unarmed but lineated plates, about one-third as wide as high. About 28 spinate plates along the base of the dorsal fins. *Intestines*—in the example figured, which is 6 inches in length, the extent of the intestinal tract is 3 inches from the pylorus to the vent. Air bladder simple. *Colours*—superiorly of a vermilion tint, with a broad and shining silvery lateral band along the whole length of the body, below which it becomes of a dull white. Pectoral fins deep blue : the other fins of a rosy hue.

Names.—*Lucerna* due to the brilliant silvery band along its side : *lanthorn-* or *shining-gurnard : long-finned captain. Le Milan*, French.

Habits.—Gregarious and when pursued springing out of the water in their efforts to escape. Pliny in old times and later both Lacépède and Risso believed that it possesses the power of displaying a conspicuous light by night, the latter author considering this faculty inherent in all examples of the genus. Cuvier observed that it arrives off the coast of Provence in the month of March.

Means of capture.—By the trawl, is said not to take a bait.

Breeding.—Supposed to be about Midsummer.

As food.—Its flesh is said to be firm, similar to that of the red gurnard, *Trigla cuculus.*

Habitat.—Well known throughout the Mediterranean and Adriatic, also occasionally found along the south coast of England. It was first brought to notice as British by Parnell, who obtained several from the Brixham trawlers by whom it was known as the *long-finned captain.* In 1849, August 9th, Mr. Cocks found one in trawl refuse, while another was procured from a fish-stall at Helford. Couch obtained it from Plymouth, where he observed it does not appear to be caught in any abundance. It has also been recorded from Bridgewater in Somersetshire.

It is said to scarcely reach to a foot in length.

Family, VI—CATAPHRACTI, *Muller.*

Body elongated, subcylindrical, or angular. Preopercle having an osseous articulation with the infraorbital ring of bones. Ventral fins thoracic. Body covered with bony plates or scales.

Geographical distribution.—This family has representatives in most seas: the species are generally of a small size, some forms being pelagic while others are more strictly littoral.

Only two Genera have been recorded from the British Isles, these being examples of a common *Agonus* or armed bull-head: the representative of the second being the rarely observed *Peristethus* or mailed-gurnard.

Genus I—Agonus, *Bloch, Schneider.*

Aspidophorus, Lacépède: *Phalangistes*, Pallas: *Cataphractus*, Fleming: *Agonomalus* and *Paragonus*, Guichenot.

Branchiostegals six: pseudobranchiæ well developed. Head and body angular and covered with bony plates. Teeth in the jaws, present or absent on the vomer, none on the palatines. Two dorsal fins, fin-rays unbranched: no free pectoral rays. Lateral-line present. Pyloric appendages few. Air-bladder absent.

Lütken remarks upon the numerous attempts which have been made to subdivide this Genus. *Agonopsis* he considers may be retained because it possesses palatine and vomerine teeth, the former having been overlooked by Kröyer. He likewise observes upon the way in which species have been unduly multiplied, *Agonus Chiloensis*, Jenyns and Günther, being the same as *A. niger*, Kröyer and Günther. Also *Agonus melarmoides*, Deslongch, being identified with *A. decagonus*, Bl. Schneider, and also with *A. spinosissimus*, Kröyer and Günther. While *Agonus cataphractus*, Fabricius, is *A. decagonus*, it being an error to suppose that *Agonus cataphractus* is found in Greenland.

Geographical distribution.—Greenland, Iceland, and as far south as the coasts of Britain, also Kamtschatka, the Kurile Islands, and *A. sturioides*, Guichenot, from China. In the South Pacific a species has likewise been taken off the coast of Chili.

1. Agonus cataphractus, Plate XXVIII, fig 1.

Cataphractus, Schonevelde, Ich. p. 30, pl. iii; Jonston, Hist. Pisc. lib. ii, t. ii, c. ix, p. 114, t. xlvi, f. 6; Willughby, p. 211, t. N. 6, f. 2, 3; Ray, p. 77. *Cottus*, Artedi, Gen. p. 49, Spec. p. 87; Gronov. Zooph. p. 79, No. 271; Klein, MSS. iv, p. 42; Pallas, Spic. vii, p. 30. *Armed bull-head*, Pennant, Brit. Zool. (Ed. 1) iii, p. 217, pl. xxxix (Ed. 2), iii, p. 293, pl. xliii.

Cottus cataphractus, Linn. Syst. i, p. 451; Gmel. Linn. p. 1207; Bloch, t. xxxix, f. 3, 4; Donovan, Brit. Fish. i, pl. xvi; Shaw, Zool. iv, p. 263, pl. xxxv; Turton, Brit. Fauna, p. 95; Faber, Faun. Grœnl. p. 155 and Fische Isl. p. 117; Gronov. ed. Gray, p. 103; Schlegel, De Dieren van Nederland, p. 50, pl. v, f. 4.

Agonus cataphractus, Bl. Schn. p. 104; Nilss. Syn. p. 95; White, Catal. Brit. Fish. p. 7; Günther, Catal. ii, p. 211; Collett, Norges Fiske, p. 38; Lütken, Vidd. Medd. 1876, p. 384; McIntosh, Fish. St. Andrew's, p. 172.

Cataphractus Schoneveldii, Flem. Brit. An. p. 216.

Aspidophorus armatus, Lacép. Poiss. iii, p. 222.

Aspidophorus Europeus, Cuv. and Val. iv, p. 201; Thompson, Pro. Zool. Soc. 1835, p. 80; Yarrell, Brit. Fish. (Ed. 1) i, p. 70, c. fig. (Ed. 2) i, p. 85 (Ed. 3) ii, p. 69; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Parnell, Fish. Firth of Forth, p. 28; Richardson, Faun. Bor. Amer. iii, p. 48.

Aspidophorus cataphractus, Jenyns, Man. p. 346; Fries och Ekstr. p. 167, t. xl; Johnston, Berwick. N. F. Club. 1838, i, p. 170; Thompson, Nat. Hist. Ireland, iv, p. 82.

Pogge, Couch, Fish. Brit. Isles, ii, p. 41, pl. lxxii.

B. vi, D. 5/5-6, P. 16, V. 1/2, A. 6, C. 12, L. l. 32, Cœc. pyl. 5-6, Vert. 11/25.

Length of head $4\frac{1}{2}$ to $4\frac{2}{3}$, of caudal fin $6\frac{1}{2}$ to 7, height of body $5\frac{1}{2}$ to $6\frac{1}{2}$ in the total length. *Eye*—2 to 3 diameters in the length of the postorbital portion of the head, 1 to $1\frac{1}{2}$ diameters apart, and nearer the snout than the posterior end of the gill covers. Head wide and depressed, the body being octagonal in shape becoming more angular and of less size posteriorly. Head covered by skin, numerous small barbels at the angle of the mouth, on the chin and over the branchiostegous rays. Interorbital space nearly flat. The maxilla reaches to beneath the front edge of the eye. Nostrils tubular, the anterior being most developed, while they are placed at some distance asunder. Two pairs of turbinal spines elevated on an osseous base on the snout, and beneath each of which are a pair of simple barbels. The posterior bone of the infraorbital ring is articulated with the preopercle, and armed with a spine at its angle: while another strong spine exists at the angle of the preopercle. Ridges on the head end in a blunt occipital and likewise suprascapular spine. There are the orifices of about ten large pores between the two preopercular spines along the inferior surface of the head, behind the lower jaws. *Teeth*—villiform in jaws, none on the vomer, palatines, or tongue. *Fins*—spines of the first dorsal rather weak and not higher than the rays of the second dorsal, which latter are unbranched. Pectoral large, and reaching to beneath the middle of the first dorsal, its rays are simple, as are also those of the anal and caudal, the last fin being nearly wedge-shaped. *Scales*—in the form of scutes covered by bony plates: two spined ridges commence one at either side of the occiput and coalesce behind the second dorsal fin, forming a single one which passes to the upper surface of the base of the caudal fin: a second commences from above the pectoral fin, and is continued to the middle of the side of the base of the caudal fin: while on the lower surface of the body a blunt ridge commences from below the base of either pectoral fin, coalescing just posterior to the end of the base of the anal, and being continued as a single ridge to the lower surface of the base of the caudal fin. *Lateral-line*—not spined, and situated between the two median ridges on the side of the body. *Cœcal appendages*—5 or 6 short ones. *Colours*—of a light gray tinged with yellow: 4 or 5 wide, and nearly black, bands pass from the back down the sides, one also goes over the head: numerous small and dark spots. Fins yellow with dark bands or marks. Pectoral yellow with numerous dark spots and two black bands. These colours become duller in adults.

Varieties.—The variations of colour in this species are considerable, and Lütken l. c. gives a table of those observed in Iceland, Denmark and Faroë.

Names.—*Pogge, armed bull-head, lyrie, sea poacher: shell-backed bull-head*, a local name. *Pluck, noble*, Scot. *Penbwl*, Welsh. *De Geharnaste Donderpad*, Dutch.

Habits.—Usually frequents shores, appearing to prefer the mouths of rivers and harbours, but has been recorded as captured some distance out at sea. In rough localities it keeps near the bottom, but does not usually frequent rocks. Its food consists of aquatic insects, worms, and small crustacea.

Means of capture.—Often taken by shrimpers, especially in sandy bays: also by the dredge, trawl, and ground seine. It has been recorded from the stomach of a haddock captured five miles from land. Its mouth is too small to admit a bait.

Breeding.—Yarrell says it spawns in May. In a female example 5 inches long

from Southend, captured in February, the eggs, which are comparatively large, were nearly ready for extrusion. Its ova are deposited among stones.

As food.—It is too insignificant to be of any value, but its flesh is said to be firm and good.

Habitat.—From the coasts of Iceland and Norway, the Baltic, the German Ocean, and around the British shores.

In Britain it is not uncommon along the south coast, but becomes comparatively rare in Devonshire and Cornwall, being more common on the eastern than on the western shores of the kingdom, and very numerous at the mouth of the Thames. In Scotland it has been recorded along the east coast at St. Andrew's, while it is said to be common on the west sands after storms. Gordon observes that in the Moray Firth in January, 1849, ten examples from 2 to 5 inches long were found in a cod-fish (Zoologist, p. 3458). In Banffshire, Edward remarks this is another stomach species,* though he also took them but sparingly among the rocks at low water. In the Orkneys and Zetland it is not common according to Baikie.

In Ireland it is said to be common around the coast: Templeton recorded an example from Carnolloc Bay, the only one he had known caught off the Irish shores.

It attains to at least 6½ inches in length, an example of this size from Brighton, having been given me by Mr. J. Carrington, F.L.S.

* A term applied to such as he has obtained from the stomachs of larger species of fish.

Genus II—Peristethus, *Kaup.*

Peristedion, Lacépède.

Branchiostegals seven: pseudobranchiæ present. Head parallelopiped in shape, the sides and upper surface cuirassed with bone: the preorbital prolonged anteriorly into a flat, projecting process. One or more barbels on the lower jaw. Teeth absent. One or two dorsal fins, the posterior of which is the most developed. Two free pectoral appendages. Body covered with bony, scale-like plates. Pyloric appendages few or in moderate numbers. Air-bladder present.

Geographical distribution.—From the south coast of Britain, through the Mediterranean, also from the Atlantic and Indian Oceans to China. A species has likewise been taken at the Sandwich Isles in the North Pacific Ocean.

These angular, and otherwise remarkably shaped, fishes appear to be pelagic forms which but rarely approach the shores, unless under abnormal conditions, as after storms. They perhaps live at considerable depths.

Peristethus cataphractum, Plate XXVIII, Fig. 2.

Lyra altera, Rondel. x, c. 9, p. 299, c. fig.; Aldrov. ii, c. 7, p. 147; Gesner, p. 517, bis; Jonston, De Pisc. lib. ii, t. 1, c. 9, p. 114, t. xxiii, f. 2; Willughby, p. 283, S. 3; Ray, p. 89. *Lyra*, Salv. f. 192. *Coccyx*, Belon. p. 209. *Trigla*, sp. 10, Artedi, Genera, p. 46; Gronov. Zooph. p. 84, No. 282. *Cataphractus*, sp. Klein, MSS. iv, p. 43, No. 4. Duhamel, Pêches, Sec. v, p. 113, pt. ix, f. 2. *Trigla Hispanorum chabrontera*, Osbeck, Nov. Act. Nat. Cur. iv, p. 201.

Trigla cataphracta, Linn. Syst. i, p. 490; Gmel. Linn. p. 1341; Brünn. Pisc. Mass. p. 72; Bloch, t. cccxlix: Bl. Schn. p. 16; Bonaterre, p. 145, pl. lix, f. 234; Gronov. ed. Gray, p 104; Martens, Reise nach Venedig. ii, p. 431.

Trigla hamata, Bl. Schn. p. 16.

Peristedion malarmat, Lacép. iii, p. 369; Moore, Mag. Nat. Hist. (2) i. 1837. p. 17, c. fig.

Peristedion cataphractum, Cuv. and Val. iv, p. 101, pl. lxxv; Yarrell, Brit. Fish. (Ed. 2) i, p. 67, c. fig. (Ed. 3) ii, p. 43; Risso, Eur. Mér. iii, p. 402; Cuv. Régne Anim. Ill. Poiss. pl. xx, f. 3; Guichen. Explor. Alger. Poiss. p. 40; White, Catal. Brit. Fish. p. 5.

Peristedion chabrontera, Lacép. iii, p. 373; Risso, l. c.

Peristethus cataphractum, Kaup, Proc. Zool. Soc. 1859, p. 105, pl. viii, f. 1; Günther, Catal. ii, p. 217.

Armed gurnard, Couch, Fish. Brit. Isles, ii, p. 38, pl. lxxi.

B. vii, D. $7/\frac{1}{18-19}$, P. 12 + II, V. 1/5, A. 18—21, C. 11. L. l, 29-30, L. tr. 3/3, Cœc. pyl. ix-x, Vert. 10/23.

Length of head $2\frac{2}{3}$, of caudal fin 8, height of body 7 in the total length. *Eyes*—the diameter equal to the postorbital length of the head, and they are rather more than 1 diameter apart. Body of an octagonal shape, decreasing in size posteriorly, while its large head has its preorbitals produced anteriorly into two flattened and rather diverging processes, the distance between the extremities of which is equal to $2\frac{1}{2}$ or 3 times in the extreme length of the snout. Two or three small spines on the upper surface of the snout. A sharp ridge passes from the preorbital to the angle of the preopercle, where it ends in a spine. Opercle with a ridge across its centre likewise terminating in a spine. Supraorbital margin serrated: interorbital space concave. A raised and spinate ridge passes from the eye to the occiput, and is continued along the base of the dorsal fin to the upper edge of the tail. Mouth inferior, not extending to beneath the eyes. A row of filiform barbels along the lower edge of the mandibles, and another beneath the chin. *Teeth*—absent. *Fins*—spines of first dorsal fin are elongated far beyond the interspinous membrane. Rays of second dorsal and anal unbranched. Pectoral with two well-developed free rays at its base. Ventral does not reach the vent. Caudal slightly emarginate. *Scales*—large and osseous, forming four raised and spinate ridges along either

side of the body, they consist of a superior one which passes close along the base of the dorsal fins to the upper edge of the tail: a similar ventral ridge along the base of the anal fin, and two intermediate parallel ridges. Three short angular scales on the base of the caudal fin. On the under surface, between the throat and the commencement of the anal fin, are three bony plates; the anterior is $2\frac{1}{2}$ times longer than wide: the middle one twice as long as wide: and the posterior one as long as wide. *Intestines*—stomach small, cœcal appendages in the form of nine or ten short processes surrounding the commencement of the small intestines. *Air-bladder*—simple. *Colours*—an uniform scarlet, becoming of a flesh or golden shade towards the abdomen. Anal and dorsal fins crimson: the remainder pale and grayish.

Names.—*Armed* or *mailed-gurnard*, in allusion to its cuirassed body and *gurnard* as relating to the fishes to which it appears to be most closely allied.

Habits.—Risso says it is present in the Mediterranean at all seasons in rocky localities, its haunts are chiefly in deep water, while it approaches shallow places in the spring. It is very active and restless: while its snout is frequently found to be damaged, probably from its driving against rocks or stones.

Habitat.—This fish does not appear to be rare in the Mediterranean, and wanderers are occasionally taken on the south coast of Britain off Cornwall.

Dr. Moore recorded the first British example in the autumn of 1836 taken in a trawl between Plymouth and the Eddystone, it was 11 inches in length. In February, 1849, a second example, $11\frac{1}{2}$ inches in length, was secured in Mount's Bay. Two were captured by a boat off Gorran, as mentioned by Couch, who received from Penzance the specimen he has figured.

For the example figured, I am indebted to Dr. Hubrecht, of Leyden. The fish is said to attain to 2 feet in length in the Mediterranean.

Family, VII—PEDICULATI, *Cuvier.*

Branchiostegals five or six: pseudobranchiæ usually absent. Skeleton fibro-osseous. Head and anterior portion of the body large, the former depressed or compressed. Preorbital not articulated with the suborbital ring of bones. Gills $2\frac{1}{2}$, 3, or $3\frac{1}{2}$: gill-opening reduced to a small foramen situated in or near the axilla. Eyes superior or lateral. Teeth minute, villiform, or cardiform. The spinous dorsal fin when present is situated well forward, and mostly composed of a few isolated spines or tentacles: the carpal bones are prolonged into a kind of arm, ending at the base of the pectoral fin: ventrals when present, jugular, with four or five soft rays. Skin smooth, or with small spines, or tubercles. Air-bladder present or absent. Pyloric appendages few or absent.

Bleeker, Gill, and some others divide the *Pediculati* into three families, *Lophoidei*, *Chironectoidei*, and *Maltheoidei.*

Geographical distribution.—Inhabitants of all seas. These fishes, due to their mode of progression, have a wide geographical range. Generally inactive, their peculiar pectoral fins enable them to walk or progress over moist ground or slimy rocks in quest of their prey, and even clasp pieces of wood or sea-weed, attached to which some are frequently carried away by currents, and have been observed far out at sea. Although bad swimmers, Dussumier remarks that *Antennarii* inflate themselves and float on the surface of the water. Some conceal themselves in the sand or mud, merely displaying their erectile first dorsal spine, which, situated on the head, is provided with an excrescence at its extremity, resembling a worm or piece of meat. By agitating this, smaller fishes are attracted and fall a prey to the artful angler. "The modified dermoneurals, forming the cephalic tentacles of *Lophius* and *Antennarius*, are as frequently reproduced as they are injured, to meet the peculiar use which these angling fishes make of them: they may be observed in every stage of growth" (Owen, Comp. Anat. i, p. 567).

Genus I—Lophius, *Artedi.*

Lophiopsis, Guich.

Branchiostegals six: pseudobranchiæ present. Head very large, broad and depressed: many spines on its surface. Cardiform teeth in the jaws and palatines, usually on the vomer, but none on the tongue. Gills three. The three anterior spines of the first dorsal fin modified into tentacles, the succeeding ones attached together by an interspinous membrane: second dorsal and anal fins short. Air-bladder absent. Pyloric appendages two.

Geographical distribution.—The fishes of this genus are littoral forms distributed throughout the seas of Europe and the coasts of North America, extending to the Cape of Good Hope, China, and Japan. The European *Lophius piscatorius* has 28-31 vertebræ and the humeral spine as a rule 3 points: *L. budegassa* of the Mediterranean has 27 to 30 vertebræ, and its humeral spine is long and simple: while the Japanese *L. setigerus* has merely 19 vertebræ.

These fishes have excited wonder in the minds of naturalists and others from the earliest ages. Aristotle observes there is a species of frog which is termed *the fisher*, deriving its name from the wonderful industry it displays in procuring food. In front of its eyes it has certain appendages resembling hairs, dilated at their extremity, forming baits. After having stirred up the mud or sand it conceals itself and elevates these appendages: the small fishes coming to seize them are drawn into its mouth. Plutarch likewise remarks that the *Lophius* fishes with a line, for it throws out from its neck a filament which it extends to a distance in the manner of a line, letting it out and drawing it back at pleasure; this being done when it perceives any little fishes about it, it allows them to bite

the extremity of this filament, being itself concealed beneath the sand or in the mud, when it gradually retracts the member until the fish is near enough to be swallowed by a quick motion.

Lophius piscatorius, Plate XXIX.

Αλιὰς βάτου, Aristot. Hist. Anim. ix, c. 27, ii, c. 13, v, c. 5 and 14. Βάτραχος Αλιὰς, Aristot. ix, c. 37 ; Ælian, vii, p. 286 ; Oppian, ii, p. 33.

Rana, Ovid, v, p. 126 ; Plin. ix, c. 24, xxv, c. 10. *Rana marina*, Belon. p 85 ; Jonst. Pisc. 1, lib. 1, tit. 1, c. 3, Art. 3, Punct. 9, p. 36, t. ii, f. 8. *Rana piscatrix*, Rondel. i, lib. 12, c. 20, p. 363 ; Salv. His. Aq. p. 129, f. 47 ; Gesner, Aquat. iv, p. 813 ; Schonev. p. 59 ; Aldrov. iii, c. 64, p. 466 ; Willughby, p. 85, t. E 1 ; Ray, Synop. p. 29 ; Rutty, Nat. Hist. Co. Dublin, p. 349 ; Leight, Nat. Hist. Lancashire, p. 186, pl. vi, f. 5 ; Borlase, Cornwall, p. 265, pl. xxvii, f. 3. *Lophius*, Artedi, Genera, p. 62, sp. 1, Synon. p. 87 ; Gronov. Mus. i, p. 57 and Zooph. p. 58. *Batrachus*, Klein, MSS. iii, p. 15, sp. 1, 2 ; Pontoppidan, Nat. Hist. Norway, ii, p. 244 ; Duhamel, Pêches, ii, sect. ix, p. 94, pl. xviii ; Ascan. Icon. t. xxxv, xxxvi ; Ström, Sond. i, p. 271. *Common angler*, Pennant, Brit. Zool. (Ed. 1) iii, p. 120, pl. xviii (Ed. 2) iii, p. 159, pl. xxi, also the *Long Angler* (Ed. 1) iii, p. 123 (Ed. 2) iii, p. 162. *The fishing-frog*, Low, Fauna Orcad. p. 183.

Lophius piscatorius, Linn. Syst. Nat. i, p. 402, and Faun. Suec. p. 108 ; Müll. Prod. Zool. Dan. p. 38 ; Retz. Faun. p. 308 ; Brünn. Pisc. Mass. p. 7 ; Bon. Ency. Ich. p. 14, pl. viii, f. 26 ; Lacép. i, p. 304, pl. xiii, f. 1 ; Bloch, iii, p. 82, t. lxxxvii ; Bl. Schn. p. 139 ; Donovan, Brit. Fish. v, pl. ci ; Turton, Brit. Faun. p. 115 ; Mitch. Lit. and Phil. Trans. N. York. i, p. 465 ; Cuv. Règ. Anim. Ill. Poiss. pl. lxxxiv ; Flem. Brit. An. p. 214 ; Richard. Faun. Bor. Amer. Fishes, p. 103 ; Storer, Mass. Rep. pp. 71, 404 ; Mohr. Isl. Nat. p. 61 ; Faber, Fisc. Isl. p. 55 ; Shaw, Nat. Misc. xi, pl. 422 ; Bonap. Faun. Ital. Pesc. iii, p. 61, c. fig. ; Cuv. and Val. xii, p. 344, pl. ccclxii ; Nilss. Skand. Fis. Faun. p. 245 ; Jenyns, Brit. Vert. p. 389 ; Risso, Eur. Mérid. iii, p. 170 ; Parn. Wern. Mem. vii, p. 253 ; Swainson, Fishes, ii, p. 330 ; Yarrell, Brit. Fish. (Ed. 1) i, p. 269, c. fig. (Ed. 2) i, p. 305 (Ed. 3) ii, p. 388 ; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 410 ; Johnston, Berwick. Nat. Club, 1838, i, p. 172 ; Gronov. ed. Gray, p. 47 ; Thomps. Nat. Hist. Ireland, iv, p. 119 ; Nord. in Demid. Voy. Russ. Mérid. iii, p. 444 ; Gaimard, Voy. Isl., &c., Poiss. pl. xix ; Guichen. Explor. Algér. Poiss. p. 80 ; White, Catal. Fish. p. 56 ; Günther, Catal. iii, p. 179 ; Schlegel, De Dieren van Nederland, p. 56, pl. iv, f. 6 ; Baird, American Nat. 1871, v, p. 785 ; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Edin. v, 1862-66, p. 614, and Fish. St. Andrew's, p. 175 ; Collett, Norges Fiske, p. 68.

Batrachus piscatorius, Risso, Ich. Nice, p. 47.

Lophius Americanus, Cuv. and Val. xii, p. 380 ; De Kay, New York Fauna, Fishes, p. 162, pl. xxviii, f. 87 ; Günther, Catal. iii, p. 181.

Lophius vomerinus, Cuv. and Val. xii, p. 381 ; Günther, Catal. iii, p. 181.

Lophius upsicephalus, Smith, Illus. Zool. S. Africa, Pisces, pl. ix ; Günther, Catal. iii, p. 181.

Angler, Couch, Fish. Brit. Isles, ii, p. 204, pl. cx.

Young.

Lophius eurypterus Düb. en kor. kgl. Vet. Akad. Handl. Stock. 1844, p. 63, t. iii, f. 1, 2 ; Nilss. Skand. Faun. iv, p. 251.

Lophius piscatorius, Günther, Ann. and Mag. March, 1861, p. 190, pl. x, f. c. e.

Monstrosities.

Lophius digitatus Ferguson, Phil. Trans. liii, p. 88, pl. xiii.

Lophius barbatus, Montinus, Act. Holm. iii, 1779, t. iv ; Gmel. Linn. i, p. 1480.

Lophius Fergusonis, Lacép. i, pp. 303, 330 ; Walb. Artedi, iii, p. 496.

Fishing frog of Mount's Bay, or *Long Angler*, Borlase, Nat. Hist. Cornwall, p. 266, t. xxvii, and Phil. Trans. Royal Soc. liii, p. 170.

Lophius Cornubicus, Shaw, Zool. v. p. 381 ; Jenyns, Brit. Vert. p. 390.

B. vi, D. 3/3/11-12, P. 13, V. 1/5, A. 9-11, C. 8, Cœc. pyl. 2, Vert. 30 (29-31).

Head large in comparison to that of the entire fish ; it is depressed, broader

than long, being orbicular anteriorly, while the body is tapering and compressed posteriorly. The height of the head is less than that of the body, and its length is from $2\frac{1}{4}$ to $2\frac{1}{2}$ or even 3 in that of the entire fish, being comparatively somewhat longer in the half-grown than it is in the adult. *Eye*—rather small, the width of the concave interorbital space equalling the distance of the eyes from the end of the snout: supraorbital ridge spined. Mouth very wide, the extent of the gape being equal to about three quarters of the greatest width of the head. Lower jaw prominent. Numerous spines over the head, and three, rarely two, on the humerus. Gill opening small and situated in the axil of the pectoral fin, where a large pouch is formed. *Teeth*—two rows of sharp cardiform ones directed backwards and curved slightly inwards, exist in both jaws, the inner row being the larger: they are more movable in the young than in the adult, giving the appearance as if hinged, and only capable of yielding inwards so as to permit entrance into but prevent exit from the mouth. Two or three teeth at either side of the head of the vomer and in a single row along the palatines: none on the tongue. *Fins*—the first dorsal fin consists of six spines, the three anterior of which are detached, filamentous, and of varying lengths; the first, inserted just posterior to the upper lip, is provided at its extremity with a rigid fleshy and glistening termination: both it, the second, and the third have also some short lateral skinny flaps. The base of the first spine is in the form of a ring which plays inside another ring, as shown in plate xxix: M. Bailly enumerates 22 muscles as attached to this spine. The succeeding three spines are connected together by a deeply cleft interspinous membrane. The second dorsal is enveloped, especially at its base, by a thick skin, which is continued from the base of the last ray to the upper caudal ray. Pectorals large and pediculated, the rays thick and unbranched. Ventral short. Anal commences rather posterior to the origin of the second dorsal. Caudal cut almost square. The skin is loose and somewhat thin, continued over the bases of the fins: numerous filaments having fringed edges are placed at short distances asunder round the lateral margin of the body in the adult, while there is one close to the base of the premaxillary, and several over the caudal portion of the body. *Colours*—generally brown, reticulated with dark lines: the outer ends of the lower surface of the pectoral and ventral fins black. Occasionally there exists a light central patch down the back, which includes some of the first rays of the dorsal fin, while some white may also exist on the pectoral and caudal fins, the latter having a vertical black band.

In the young—(see fig. 2) the head is broader than long, but less depressed than in the adult. The depression increases with age, while the spines of the first dorsal fin have lateral soft branched enlargements along their anterior and posterior edges. These immature forms, however, appear to be very rarely captured.

Varieties—Ferguson's Angler and Borlase's Long-Angler appear to be monstrosities, *i.e.*, deformed or mutilated examples of this fish. *L. vomerinus*, the Cape of Good Hope, has no teeth on the vomer in the single example known.

Names.—*Angler*, a term applied to this fish by Pennant owing to its habits: *fishing-frog*, *frog-fish*, its hideous aspect having been considered to give it some distant resemblance to frogs in their tadpole condition: *sea-devil*, *monk-fish*, *toad-fish*, *nass-fish*. In Scotland, *wide-gab*: *kethrie*, Moray Firth. *Morlyffant*, Welsh. In Ireland, *friar*, *molly-gowan* and *briarbot*: at Strangford Lough termed *kilmaddy*. *Le Baudroye commune*, French. *De zee-duivel*, Dutch. Whether this fish was ever the type of the ridiculous images of demons and goblins in times gone by, as suggested by Lacépède, is probably open to discussion. Its ventral with five digits, its pectoral with hinged arm-like bases might, he believes, have been looked upon as arms and legs; and its enormous head as an exaggeration of that of man. It received the name of *diable-de-mer*, while its skin prepared so as to be transparent, and made luminous by a light placed in its interior, has frequently served to make people of not over strong intellects believe that they have seen apparitions.

Habits.—Inactive, but with an insatiable appetite, which its slow progression

compels it to gratify by stratagem. During the summer and autumn it resides near the shore, where by means of its pectoral fins, it forms for itself a cavity in the sand, or should the ground be rough, it lies as if dead, where its floating filaments, kept in motion by the tide, decoy other fish, and the angler's tendril is no sooner touched than the game is caught. They swallow shell fish, and in fact almost any substance not too large. At times, however, even these stratagems fail in obtaining for them sufficient nourishment, and then they have been known to leave the bottom seeking for food at a higher elevation. Couch mentions how a fisherman had hooked a cod-fish, and while drawing it up he felt a heavier weight attach itself to his line, which proved to be an angler of large size, and only relaxed its hold on receiving a heavy blow on the head. On another occasion one seized a hooked conger eel, *Conger vulgaris*, the latter struggled until it obtained an exit through the gill opening of the angler, and both were thus drawn up together. They will even come to the surface* and gorge anything they imagine may be useful as food. Mr. Blake-Knox recorded how one of these fishes was brought to him with a cormorant, *Phalacrocorax carbo*, in its throat, which had been swallowed as far as its shoulders: the bird struggled, and both were seen on the surface of the water and captured. In another instance the same exhibition was witnessed, the bird being a gull, *Larus argentatus*, that measured nearly 4½ feet from tip to tip of its wings, but as the angler's capacity was limited, it being only 3 feet long, the bird's feet, tail, and ends of its wings projected from the fish's mouth, causing the latter to be choked. An angler has been seen to seize a northern diver, *Colymbus gracialis*, and the two were secured by a fisherman while they were struggling for mastery. An entire and perfectly fresh widgeon, *Anas penelope*, has been taken from inside one at Belfast, while a similar occurrence has been recorded from Youghal, with this difference, that the bird was said to be alive. They have also been known to devour guillemots, *Uria troile*, and razor-bills, *Alca torda*, and would doubtless swallow any bird they could capture. They are not always discriminating as to the substances which they engulf, one has been known to swallow a large block of granite, used as an anchor-stone for fishing, it was however covered with blood, slime, and fish-scales (Zoologist, 1865, p. 9470). A few years since one gorged the white-washed cork buoy of a crab-pot, and from its being unable to sink again with it, became strangled and was so caught.† Skates, gurnards, and various fishes have been taken from their stomachs. Pennant among these included the dog-fishes, and for this reason he remarks that in his time the fishermen near Scarborough returned those captured to the sea. Parnell says that some fishermen at Queensferry, seeing the water much discoloured at a particular spot near the shore, poked the bottom with a long-handled mop: an angler seized it, and before it could disengage its teeth, was hauled into the boat. It measured 4 feet 9 inches in length. Mr. Todhunter observed an angler in shallow water near the shore at Youghal, and presented the butt end of his whip to it, this it seized and held on to so firmly that it was actually dragged on shore. Johnston relates how one of these fishes, having been left on the beach by a receding tide, a fox came along searching for provender; chancing to thrust his nose inside the jaws of the angler, they closed, and thus reynard was held until observed by passers by. Thompson tells us that these fishes are frequently killed at Keem in Achil by the receding waves carrying back quantities of sand, which getting into their mouths, disables them, and being thus seen from the shore, they are, in their extremity, approached and despatched with pitchforks.

Their muscular pectoral fins enable them to creep along the ground, consequently they are able to move about without agitating the water, as they would have to do were it necessary to use their tails for progression. Rondelet asserted that they live for a long time after their removal from the water: Cuvier considered the contrary to be the case, while Couch observed that when the skin

* Mr. R. Couch states that the *Lophius* "frequently rises to the surface of the water in the summer and autumn, and lies basking in the sun."

† R. Couch, Zoologist, 1847, p. 1609.

has been kept moist the fish has been known to live out of its proper element for several days. Some authors have supposed that the young of these fishes when alarmed seek for shelter in the branchial pouch in the axilla of the pectoral fin. Thompson alludes to an instance mentioned in a Dublin newspaper, wherein a man bathing at Kingstown was seized by the leg by a *Lophius*, and considerably injured: the fish was said to have been captured, so there was no doubt as to the species. Montague has remarked that even when captured its rapacious appetite is not destroyed, as it generally devours some of its fellow prisoners, which, especially flounders, have been occasionally taken from its stomach alive.

These fishes have also been watched when in confinement, thus Mr. Saville Kent (*Field*, Nov. 14th, 1874) tells us that at the Brighton Aquarium the angler gave the appearance of a mass of rugged rock, the lower jaw being like a ledge from which are dependant small fleshy tentacles, a line of which are continued backwards along the sides to the tail. These resemble small, flat, calcareous sponges, *Grantia compressa*, Ascidians, Zoophytes, and other low organisms, which are found on the lower margin of every rocky ledge. On its head are two large tendrils employed for alluring prey, the foremost of which, by its digitated membrane is the facsimile of a young frond of oar-weed, *Laminaria digitata*, both in shape and colour: and in the tendril behind it we have a repetition of the same, with the blade of the frond, as it were, worn away by the current of the ocean. The large and prominent eye has the aspect of a hollow, truncated cone, and with its longitudinal stripes, resembles the shell of an acorn barnacle with an amount of exactness which is patent to the most ordinary observer. Lying prone at the bottom of the ocean, among rocks and *débris*, it might well pass muster as an inanimate object, which other fish could approach with impunity, and not discover their error until too late to escape from its merciless jaws. When it first discovers its prey, it becomes excited, and works its worm-like filament, which is furnished with a glittering piece of skin at the top, which acts as a lure to the small fish. This curious appendage is used just as if the creature was going to throw a fly to tempt the fish. In the crevice of some marine cliff it has merely to remain quiet, allowing its tendrils to sway about, moved by the current, as are the surrounding weeds, and his diet, foraging about for their food, become a prey for his larder.

To demonstrate their slowness of digestion, Couch remarks that "on one occasion there were nearly three-quarters of a hundred herrings found in the stomach of an angler, and so little change had they suffered, that they were sold by the fishermen in the market without any suspicion in the buyer of the manner in which they had been obtained." In another instance, twenty-one flounders and a dory were similarly found and disposed of. Fishermen often open these fishes to obtain the contents of their stomach.

Means of capture.—Sometimes trawled, also taken by nets and baits. Pennant's remark that the fishermen about Scarborough return them to the sea because they devour dog-fishes, is repeated in the Zoologist (p. 3333) as also applicable to the Bristol Channel. There is no doubt they are very destructive to other fishes, while considering the wonderful number of eggs they deposit, but the comparatively few young that are seen, they must be subject to some wholesale destruction as fry, or else when in the ova state.

Breeding.—In December, 1841, Thompson examined an example $4\frac{1}{2}$ feet in length: it was a female with the ova, well-developed, computed to number 1,427,344, each ovum was 1/32 part of an inch in diameter, and the total when weighed were found to be 1 lb. 13 oz. avoirdupois. Baird l. c. has recorded the spawn of this fish resembling a floating sheet of mucus from sixty to one hundred feet square. Valenciennes says of an example only two inches in length, that the pectoral and ventral fins are very long, while the spine has more numerous and much longer tentacles than the adult: and that some of the pectoral rays extend a good distance beyond the membrane. Düben obtained the young in Norway, but which appeared to differ so from Valenciennes' account that he considered it new, terming it *L. eurypterus*, the first dorsal spine terminating in a transverse cylindrical knob, provided with cilia, and being scarcely above half the length of

the second spine. Risso states that the female attains to a larger size than does the male.

Diseases.—McIntosh, l. c. Fishes of St. Andrew's, observes that this fish is "common off the West Sands and frequently captured in the salmon nets. One of the specimens had acute pericarditis."

As food.—Usually rejected in Great Britain, but said by Willughby and Donovan to have very delicate flesh, resembling that of a frog, and to be eaten in some countries; and Couch, that a private individual reports our angler to be a delicious fish. Johnston says it was produced at a feast given to a king of Thrace; and Parnell observes that "the flesh is considered good, particularly that near the tail."

Habitat.—This species is said to be seldom captured north of 60° north latitude, and though rare on the coasts of Denmark and in the Baltic, it extends southwards in the Atlantic as far as the Cape of Good Hope, and also throughout the Mediterranean. It is frequent in Newfoundland,* and along the eastern shores of North America to as far south as Cape Hatteras in North Carolina.

Although Low in his account of the Orkneys did not consider it to be common, Baikie reported it as tolerably frequent both there and in the Shetland Isles. It is taken all round the British coast, but largest in numbers towards the south, and is numerous in Cornwall throughout the year, but most frequently observed during fine weather in summer or autumn, at which time it approaches the shore. It is common in the North Sea, and frequently met with off Banffshire (Edward), in the Moray Firth (Harris), and the Firth of Forth (Parnell). Dr. Lowe observes that it is not uncommon in Norfolk estuary, where it sometimes attains a large size: but one taken in the Humber in May, 1845 (Zoologist, p. 1035), was considered, owing to its supposed rarity, to be worth recording.

In Ireland it is common round the coast, but is said to seldom exceed four feet in length. On the north-east coast the fishermen open them to ascertain the contents of their stomachs, after which they are thrown overboard and become washed ashore; they reject them as food. On the south-west coast of Cork they are detested, and as soon as taken the fishermen strike their heels into the posterior part of the fishes' skulls, and then throw them overboard: not only do they reject them as food but they rarely if ever open them.

This fish, although generally measuring up to $2\frac{1}{2}$ or 3 feet in length, may attain to 6 or 7 feet. The example figured is about 11 inches long and from the south coast.

Saxby, Zoologist, 1871, p. 2553.

Family, VIII—TRACHINIDÆ, *Risso.*

Branchiostegals from five to seven: pseudobranchiæ present. Body more or less elongated, posteriorly compressed. Eyes more or less lateral. Cleft of mouth almost horizontal, lateral, or even nearly vertical. Some of the bones of the head are usually armed: the suborbital ring of bones does not articulate with the preopercle. Teeth in the jaws small and pointed, present or absent on the vomer and palatines. One or two dorsal fins, the rays being generally considerably more in number than the spines: anal similar to soft dorsal: no finlets. Ventrals thoracic with one spine and five rays. Pectorals with or without appendages. Body scaled or scaleless. Air-bladder present or absent. Pyloric appendages few.

Geographical distribution.—Cosmopolitan, rarely of large size. The majority are littoral forms, some entering freshwaters or rivers, while a few are present among coral reefs. Although in some Genera, as *Sillago*, these fishes are rather rapid in their movements, the majority included in this family are the reverse, some being very inactive.

Genus I—Trachinus, *Cuvier.*

Branchiostegals six: pseudobranchiæ present. Body elongated and cylindrical, with the cleft of the mouth very oblique. Eyes lateral, directed somewhat upwards and outwards. Preorbital and preopercle serrated: opercle with a strong spine. Villiform teeth in the jaws, on the vomer and palatine bones, none on the tongue. Two dorsal fins, the first with five to seven spines: second dorsal and anal many rayed. Ventrals jugular. The lower pectoral rays unbranched. Scales cycloid and very small. Air-bladder absent. Pyloric appendages few.

The term *Trachinus* has been referred to several Greek derivations, but the most simple is that it is a latinized corruption of *dracœna* (δράκαινα) which is still its Greek name, as well as signifying a dragon or serpent; while its likewise being called *araneus*, or a "spider" by the Latins also had reference to the poisonous character of the wounds it inflicts. Two species frequent the British coasts, the larger *Trachinus draco*, the smaller *Trachinus vipera*, the latter being the more venomous. Ancients asserted that so dreaded were they even by their finny neighbours that all gave place to the weever. Opinions have been much divided respecting the seat of the virus or poison; some, as Rutty, asserting that such resided in "the fin near the neck which has five prickles which are the seat of what is called its venom." Others have limited the poisoned wounds to such as are inflicted by the opercular spines. But it has been shown* that both the double grooved opercular spines and also those of the first dorsal fin are poison organs, the latter of which besides being grooved, contains a cavity within the substance of the spine where the poison would seem to be deposited prior to its use, while means by which such could be ejected have not yet been discovered. No specific poison-gland has been found, but it has been surmised that the virus is a secretion or excretion from the mucous surface of the loose skin which covers the spines, or its pulpy sheath, this substance would collect in the grooves, and when penetrating a foreign body sufficiently deep would naturally be introduced into the inflicted wound. Even the death of the fish does not appear to at once arrest its virulence, as pricks from the spines of dead weevers have been observed to occasion symptoms of poisoning.†

* Byerly, Proc. Liverpool Lit. and Phil. Soc. i, p. 156.

† On the poisonous nature of wounds caused by these fishes, see Schmidt, Nord. Med. Ark. vi, No. 2, 1875.

When sea bathing, the possibility of receiving wounds from these fishes may not unfrequently be a subject for bathers to dread, especially should the coast be a sandy or gravelly one, such being the favourite localities for the weever to reside in, and where it buries itself, leaving merely its head uncovered. Woe to the unprotected foot that incautiously treads on one of these fishes, as when alarmed they at once strike any foreign body with the spine with which their gill-cover is armed, directing their blows, as Pennant observes, with as much judgment as fighting cocks. A few months since, remarks R. Couch (Zoologist, 1846, p. 1402), I saw a *Trachinus draco* which had just been caught, and as it lay at the bottom of the boat I frequently threw some sea-water over it to keep it living, and then irritated it with a stick. But whichever part of the body I touched it unerringly struck it with its spines, by bending the body and throwing its head back with a rapid jerk.

In Banffshire* a man was wounded taking a large weever off a hook, and in less than half-an-hour the whole of his hand was considerably swollen: the swelling went on extending to the wrist, and the two middle fingers being more in the line of the wound, were more swollen than the others. In about an hour the hand had increased to twice its natural size. It was scarified by a surgeon, and other means used, which arrested the progress of the attack; the hand healed up perfectly within a reasonable time. As a rule, the pain appears to subside in about twelve hours, or as some fisherman imagine, the effects of the poison will last until the tide returns to the same height as it stood when the injury was inflicted. But a sailor, having been wounded by what was supposed to be a weever, his leg became painful and in the course of a few hours was much swollen and inflamed, while many weeks elapsed before he was able to resume his usual occupation.†

Wherever shrimps abound weever fishes are said to be present, and shrimpers in dark nights have been known to be afraid of picking their captures out of their nets fearing lest one of these fishes might be among them.

It is safest for bathers in localities where these fishes are found to take the precaution of wearing bathing-slippers, because should they incautiously put a foot upon a weever it may wound with the spines of the first dorsal fin, which it can erect or depress at pleasure, or strike violently with its armed head. Great pain is immediately experienced, and which rapidly spreads. Pliny and Dioscorides advised that the body of the fish should be cut open and applied to the wound, a process to which two objections may be fairly raised: first, the necessity of capturing the fish, and secondly the improbability of any alleviation following the employment of such a remedy. Paul of Ægina's receipt would hardly have much effect, it being to make the patient drink a light tisane thickened by the brains of the culprit fish. Avicenna suggested a poultice of leeks; Rondelet, leaves of the lentiscus bruised; while various animal and vegetable substances soaked in vinegar or made into salves have been proposed. Cuvier suggested as the most simple and surest cure to enlarge the wound caused by the spine of one of these fishes. Fishermen occasionally recommend friction of the part with sand, but surgeons have found that olive oil, to which opium has been added, is most efficacious. At the mouth of the Tyne, where these fish are numerous, Mr. Green observes (Science Gossip, 1873, p. 283) that shrimpers generally carry a small bottle of sweet oil to apply in case they are stung.

Geographical distribution.—From the coast of Scandinavia, through those of Western Europe, the British Isles, and the Mediterranean; also Madeira, and along the western coast of Africa as far south as the Cape of Good Hope; while Kner recorded *T. draco* from Iquique in Peru.

1. Trachinus draco, Plate XXX.

Δράκων, Arist. viii, c. 13; Ælian, ii, c. 50.

Araneus, Pliny, ix, c. 48. *Draco marinus*, Pliny, ix, c. 27; Salv. f. 71. *Draco*, Rondel. x, c. 10, p. 300, c. fig.; Aldrov. ii, c. 50. *Draco marinus major*,

* Harris, Zoologist, 1854, p. 4260. † Briggs, Zoologist, 1854, July.

Jonston, tit. iii, c. 3, punct. 2, p. 91, t. xxi, f. 2; Willughby, p. 288, t. S. 10, f. 1; Ray, p. 91; Rutty, Co. Dublin, i, p. 358. *Trachinus*, No. 1, Artedi, Gen. p. 42; Gronov. Zooph. p. 80, no. 274; Duhamel, Pêches, ii, p. 235. *Greater weever*, Pennant, Brit. Zool. (Ed. 1) iii, p. 171, pl. xxix (Ed. 2) iii, p. 229, pl. xxxiii.

Trachinus draco, Linn. Syst. Nat. i, p. 435; Brünn. Pisc. Mass. p. 19, no. 30; Gmel. Linn. p. 1157; Risso, Ich. Nice, p. 108, and Europ. Mérid. iii, p. 260; De la Roche, Ann. Mus. xiii, p. 331; Martens, Reise nach Venedig, ii, p. 429; Cuv. and Val. iii, p. 238; Johnston, Fish. Berwickshire, Mag. Nat. Hist. vi, 1833, p. 15; Jenyns, Man. Brit. Vert. p. 335; Yarrell, Brit. Fish. (Ed. 1) i, p. 20, c. fig (Ed. 2) i, p. 24 (Ed. 3) ii, p. 1; Fries och Ekstr. Skand. Fisk. p. 13, t. iii, f. 1; Swainson, Fishes, ii, p. 270; Nord. in Demid. Voy. Russ. Mérid. Poiss. p. 370; White, Catal. Brit. Fish. p. 13; Gron. ed. Gray, p. 46; Günther, Catal. ii, p. 233; Schlegel, De Dieren Neder. p. 37, pl. v, f. 5; Kner, Sitz. Ak. Wiss Wien, 1867, lvi, p. 717; Steindachner, Ich. Span. u. Port. 1867, p. 95; Collett, Norges Fiske, p. 42; McIntosh, Fish. St. Andrew's, p. 173.

Trachinus lineatus, Bl. Schn. p. 55, t. x; Risso, Ich. Nice, p. 109, and Eur. Mérid. iii, p. 260.

Trachinus major, Donovan, Brit. Fish. v. pl. cvii; Flem. Brit. Anim. p. 214.

Trachinus armatus (Schlegel), Bleeker, Poissons de la côte de Guinée, p. 94.

Greater weever, Couch, Fish. Brit. Isles, ii, p. 43, pl. lxxiii.

B. vi, D. 5-6/29-31, P. 16, V. 1/5, A. 31, C. 12, L. l. 78. Cœc. pyl. 6. Vert. 11/31.

Length of head $4\frac{1}{4}$, of caudal fin 8, height of body $5\frac{1}{2}$ to $6\frac{1}{2}$ in the total length. *Eye*—5 to $5\frac{1}{2}$ diameters in the length of the head, 3/4 of diameter from the end of the snout, and 3/4 to one diameter apart, the upper portion of the globe of the eye having an opaque eyelid continued on to it. Dorsal profile nearly horizontal, that of the abdomen more convex; body compressed. Cleft of mouth very oblique, reaching to slightly behind the posterior edge of the orbit; lower jaw somewhat the longer. Two small spines at the anterior superior angle of the orbit; interorbital space rather concave. Four flat and badly marked spines on the preopercle and which are sometimes absent, two being on the lower limb, the anterior of which points forwards. Opercular spine long, strong, and enveloped in loose skin nearly to its end. Suprascapular a short flat plate (rough along its edges) while the scapular is rather larger, but of a similar character. *Teeth*—villiform in jaws, vomer, palatines and pterygoid bones; none on the tongue. *Fins*—second and third spines of the first dorsal the longest, the membrane from the last spine is continued almost to the base of the first ray of the second dorsal. Lower six pectoral rays unbranched, or with the divisions very indistinct. Caudal slightly emarginate, almost square. *Scales*—cycloid and in oblique lines passing down the body, some also on the sides of the head. *Lateral-line*—passing along the upper fourth of the body. Vent beneath the vertical from the last dorsal spine. *Colours*—generally gray or yellow, being darkest along the back: brown or bright yellow lines pass down the body in the direction of the rows of scales, decreasing in vividness as they descend; while the upper surface and sides of the head are reticulated or spotted with brown or gray, and occasionally with blue lines; some yellow stripes along the gill covers. First dorsal fin black in its upper three-fourths, sometimes nearly entirely so. The other fins yellowish, their outer edges stained darkest, while the posterior margin of the caudal is nearly black and some dark reticulations exist on the fin. Old examples are less vividly marked than the smaller ones, while the colours rapidly fade after death.

Names.—The term *weever* is stated to be a corruption of the French *La vive* which this fish was named, due to its existing a long time after removal from the water, but Yarrell referred it to the Anglo-Saxon *wivere* "a serpent," the *wivern* being the heraldic dragon. In fact Rondelet considered it to be the veritable *draco* of the ancient naturalists. Locally known in Sussex as *sea-cat*: also as *cat-fish* and *sting-bull*. The *Sand-eel-bill* of Ayrshire, so much dreaded by the fisherman there, is probably this fish. *Mor wiber fawr*, Welsh. *De Pieterman*, Dutch.

Habits.—It swims near the ground, burrowing in the sand, as already de-

scribed, and though it may be left uncovered by an ebbing tide, it is highly retentive of life. It lives on the fry of other fishes or small animals, and remains on our coasts throughout the year. Couch states that he has known the greater weever taken in a net floating over 35 fathoms of water, and when several have been thus caught, it has always been of an early morning east of the nets, as if they thus mounted aloft only in the darkness of the night. From the inside of one example, two gobies and a sand launce were taken, from another a squid, *Loligo media*, 5 inches in length. In the Westminster Aquarium these fishes do not show any propensity to conceal themselves under the sand, a proceeding said to be more in vogue with *Trachinus vipera*.

Means of capture.—Sometimes taken by the trawl, in sprat or shrimp nets, or else by a baited hook attached to a deep sea line. It is most commonly captured during summer and autumn.

Breeding.—On the continent of Europe these fish approach the shore in large numbers in the month of June for the purpose of depositing their ova. They doubtless choose the same time in this country, and Couch mentions an example 3/4 of an inch long having been captured in August by a drift net.

As food.—This form, not *T. vipera*, are sold in Whitechapel as food, and are said to be known as *Spitalfield weavers:* they are esteemed in France not only because they can be conveyed long distances alive, but likewise owing to the considerable time they remain fresh after death. A police regulation existed at Boulogne that they might not be disposed of until their back fin had been removed, in order to prevent persons being injured by it.

Habitat.—From Scandinavia and Western Europe through the Mediterranean, and it has been recorded from Madeira, New Guinea, and on the Western coast of Africa as far as the Cape of Good Hope, also from Peru.

In Britain it is by no means uncommon along the coasts, especially on the west, decreasing in numbers towards the north. At St. Andrew's it is frequent on the west sands after storms (McAndrew): it is occasionally found in Banffshire according to Edward, however in the Zoologist for 1857, p. 5834, one is recorded as captured there the first week in October, and the writer states that the last taken previously was in 1810.

In Ireland Andrews records it from Ventry Bay, but it has not been found in the north, in fact Thompson did not believe in its occurrence there.

The example figured is 12 inches long, and was sent alive from Brighton to the Westminster Aquarium. It attains to at least 17 inches in length.

2. Trachinus vipera, Plate XXXI.

Otterpike, Willughby, i, p. 289. *Araneus minor*, Ray, p. 92; Duhamel, Pêches, ii, p. 135, pl. l. fig. 2. *Trachinus*, var. Gronov. Mus. Ich. i, p. 42. *Draco minor*, Jonston, Pisc. t. iii, c. 3, punct. 2, p. 92, t. xxi, f. 3. *Draco marinus*, Borlase, Nat. Hist. Cornwall, p. 270, pl. xxvi, f. 3. *Common weever*, Pennant, Brit. Zool. (Ed. 1) iii, p. 169, pl. xxviii (Ed. 2) iii, p. 226, pl. xxxii.

Trachinus draco, Bloch, t. lxi; Bonaterre, Ency. Ich. p. 45, pl. xxviii, f. 98; Bl. Schn. p. 55; Donovan, Brit. Fish. i, pl. xxiii; Turton, Brit. Fauna, p. 89; Risso, Ich. Nice, p. 108, and Eur. Mérid. iii, p. 260; Flem. Brit. An. p. 213.

Trachinus vividus, Lacép. Hist. Nat. Poiss. ii, p. 354.

Trachinus vipera, Cuv. and Val. iii, p. 254; Parnell, Fish. Firth of Forth, p. 12; Yarrell, Brit. Fish. (Ed. 1) i, p. 25, c. fig. (Ed. 2) i, p. 29 (Ed. 3) ii, p. 7; Jenyns, Manual Brit. Vert. p. 336; Johnston, Berwick. Nat. Club, 1838. i, p. 170; White, Catal. Brit. Fish, p. 13; Cuv. Règne Anim. Ill. Poiss. pl. xv; Guichen. Explor. Sc. Algér. Poiss. p. 36; Schlegel, De Dieren Neder. p. 40, pl. v, f. 6; Thompson, Nat. Hist. Ireland, iv, p. 70; Günther, Catal. ii, p. 236; Steind. Ich. Span. u. Port. 1867, p. 95; McIntosh, Fish. St. Andrews, p. 173.

Trachinus horridus, Gronov. ed. Gray, p. 46.

Viper weever, Couch, Fishes of Brit. Isles, ii, p. 48, pl. lxxiv.

B. vi, D. 6/21-24, P. 14, V. 1/5, A. 25-26, C. 12, L. l. 65, Cœc. pyl. 6, Vert. 10/25.

Length of head, $3\frac{1}{2}$ to $3\frac{3}{4}$, of caudal fin $6\frac{1}{4}$ to $6\frac{1}{2}$, height of body $4\frac{1}{2}$ to 5 in the total length. *Eye*—diameter $4\frac{2}{3}$ in the length of the head, 1/2 to 2/3 of a diameter from the end of the snout, and 1/2 a diameter apart. Very similar to *T. draco*, but has no spines above the orbit. Interorbital space concave. Two sharp and forwardly directed spines below the angle of the preopercle. Opercular spine rather long, strong, and straight. The maxilla reaches to beyond the vertical from the hind edge of the orbit. A row of small papillæ along the upper edge of the lower lip. *Teeth*—villiform in jaws, vomer, palatines, and pterygoid bones, none on the tongue. *Fins*—second and third spines of the first dorsal fin the longest. Lower five or six pectoral rays unbranched, or with the divisions very indistinct. Caudal very slightly emarginate. *Scales*—scarcely any on the head. *Colours*—back gray, becoming paler towards the abdomen, where it is tinged with yellow. Several narrow longitudinal irregular gray lines pass along the back, and are continued on to the head, which may also be spotted with black. First dorsal fin black, with some narrow white lines posteriorly. Fins yellowish. Caudal yellow, with a dark base, and a wide black band along its posterior margin.

Names.—*Little-* or *lesser-weever: sting-fish.* Locally termed *adder-pike: black-fin: otter-pike. Mor wiber*, Welsh. *Stangster* or *Stang*, Celtic, Moray Firth (Gordon). *Bishoped* or stung by a *bishop*, one of these fish, Cornwall. *Stony-cobbler*, Youghal (Ball) (see *poison pate*, p. 50, ante). *De Kleine Peterman*, Dutch.

Habits.—This species is rather more active and much more venomous than *T. draco.** Dr. Lowe, in his Fauna of Norfolk, while quoting Sir J. Browne's list, and his assertion that "it has a short, small prickly fin along the back which often venomously pricketh the hands of fishermen," combats the idea, contending that although he has watched them carefully he could only observe that they made sudden bounds with their fins extended, as do many other species.

Means of capture.—Sometimes taken in sprat nets, or by baits when small hooks are used. Ogilby observes that it is said to take a fly when towed after a boat.

Breeding.—In spring.

As food.—It is stated to be exceedingly good meat (Pennant), and they are taken in great numbers in Holland.

Habitat.—From the North Sea and British coasts along those of France and Spain to the Mediterranean; while two bad specimens of fish from the Seychelles existed in the British Museum which the curator has referred to this species.

Common on the English coast, in some places being more abundant than the *T. draco:* they do not appear to be quite so frequent in Scotland. Edward found them the most numerous of the two in Banffshire, and Baikie (Zool. 1853) records a couple from the Orkneys and one from Kirkwall Bay. In Ireland they are most common along the eastern and southern shores, but are present from the north to the south, Ball states them to be very abundant at Youghal.

Ogilby records as a very unusual sized example, one $6\frac{1}{8}$ inches in length, taken at Portrush, in the country of Antrim, where they are not uncommon (Zoologist, 1876, p. 4753).

The example, figured life size, was taken at Weston-super-mare in a shrimp net.

* See a paper on the stinging properties of this fish, Allman, Ann. Nat. Hist., Nov. 1840.

Family, IX—SCOMBRIDÆ, *Cuvier.*

Branchiostegals seven or eight: pseudobranchiæ present. Body oblong or slightly elongated and rather compressed. Gill-openings wide: eyes lateral. The infraorbital bones do not articulate with the preopercle. Teeth present in the jaws, but may be absent from the palate. Two dorsal fins, the first being distinct from the soft, which has more rays than the first has spines: finlets present or absent: ventrals thoracic. Sides of the tail sometimes keeled. Scales, when present, small. Air-bladder present or absent. Pyloric appendages numerous, in moderate numbers, or dendritical.

Fishes of the Mackerel family are pelagic forms, readily distinguishable by their elegant shapes and brilliant colours, while they are mostly highly prized for the table. Carnivorous and exceedingly active, their shapes are well adapted to enable them to glide rapidly through the water: while to obviate the least impediment, we even find in some depressions for the reception of the pectoral fins.

Genus I.—Scomber, *Artedi.*

Cordylus, Gray.

Branchiostegals seven: pseudobranchiæ present. Body rather elongated and compressed. Eyes with adipose lids. Cleft of mouth deep. Small and deciduous teeth in the jaws: similar ones present or absent on the vomer and palatine bones. Two dorsal fins, the first spinous and separated by an interspace from the second, behind which latter and also posterior to the anal fin are five or six finlets: fewer spines in the first dorsal fin than there are rays in the second dorsal or in the anal: ventrals thoracic. A slight keel along either side of the root of each lobe of the caudal fin. Scales small. Air-bladder, when present, simple. Pyloric appendages numerous.

Geographical distribution.—These fishes have a very extensive range, being found in most temperate and tropical seas of both Hemispheres, but do not appear to have been received from the American shores of the South Atlantic Ocean. Only two distinct species have as yet been recorded from the British Isles.

1. Scomber scomber, Plate XXXII and XXXIII.

Σκόμβρος, Arist. vi, c. 17, viii, c. 12 and 13, ix, c. 2; Ælian, xiv, c. 1; Athen. iii, 112, vii, 321; Oppian, Halieut. i, fol. 108, 109.

Scomber, Ovid, Halieut. v, 94; Pliny, ix, c. 15, xxxi, c. 8, xxxii, c. 11; Martial, iii, Ep. 2, iv, Ep. 86, xiii, Ep. 1; Rondel. viii, c. 7, p. 234, c. fig.; Salvian. p. 241, f. 239 b. 241, 242; Gesner, fol. 57; Schonev. p. 66; Aldrov. ii, c. 53, p. 270; Jonston, De Pisc. lib. i, tit. iii, c. 3, punct. 6, p. 95, t. xxi, fig. 10; Willughby, p. 181, t. M. 3; Ray, p. 58; Rutty, p. 356; Ström, Sönd, ii, p. 295. *Scomber*, No. 1, Artedi, Genera, p. 30, Synon. 48, Species, p. 68. *Scomber*, sp. Gronov. Zooph. p. 93, No. 304. *Pelamys*, sp. Klein, MSS. v, p. 12, No. v, t. iv, f. 1; Duhamel, Pêches, sect. vii, pl. 1, f. 1; Cetti, Hist. Nat. Sard. iii, p. 190. *Mackrel*, Pennant, Brit. Zool. (Ed. 1) iii, p. 264, pl. li (Ed. 2) iii, p. 357, pl. lxii. *The mackerel*, Low, Fauna Orcad. p. 218.

Scomber scomber (or *scombrus*) Linn. Sys. i, p. 492; Brünn. p. 68; Bloch, t. liv; Gmel. Linn. p. 1328: Bl. Schn. p. 24; Lacép. iii, p. 24; Shaw, Zool. iv, p. 577, pl. lxxxiv; Donovan, Brit. Fish. v, pl. cxx; Turton, p. 100; Pallas, Zoogr. Russ. Asiat. iii, p. 215; Risso, Ich. Nice, p. 170 and Europ. Mérid. iii, p. 412; Martens, Reise nach Venedig. ii, p. 432; Cuv. and Val. viii, p. 6; Fries och Ekst.

Skand. Fisk. p. 128, t. xxix; Jenyns, Man. p. 360; Yarrell, Brit. Fish. (Ed. 1) i, p. 121, c. fig. (Ed. 2) i, p. 137 (Ed. 3) ii, p. 193; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Parnell, Fish. Firth of Forth, p. 50; Johnston, Berwick. Nat. Club. 1838, i, p. 171; Swainson, Fishes, ii, p. 238; Cuvier, Règne Anim. Ill. Poiss. p. 29; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 391; White, Catal. Brit. Fish. p. 29; Thompson, Nat. Hist. Ireland, iv, p. 92; Günther, Catal. ii, p. 357; Schlegel, De Dieren Nederland, p. 5, pl. v, f. 1; Steind. Ich. Span. u. Port. 1868, p. 1; Collett, Norges Fiske, p. 43; A. Malm, Œfv. Ak. Förh. 1876, pl. v; McIntosh, Fish. St. Andrew's, p. 173; Winther, Prod. Ich. Dan. 1879, p. 12.

Scomber vulgaris, Flem. Brit. Anim. p. 217.

Scomber vernalis, Mitchell, Trans. Lit. and Phil. Soc. New York, i, p. 423; Cuv. and Val. viii, p. 48; Storer, Fish. Mass. p, 41; De Kay, New York Fauna, Fish, p, 101, pl. xii, f. 34; Richards., Faun. Bor. Amer. Fish. p. 80.

Cordylus scombrus, Gronov. ed. Gray, p. 163.

Makarel and *Dotted Makarel*, Couch, Fish. Brit. Isles, ii, pp. 67, 81, pl. lxxix and lxxxi, fig. 1.

Scomber punctatus, Couch, Zoologist, 1849, p. xxix, append. c. fig. and Penzance, Nat. Hist. Soc. 1848, pl. iii, f. 1; White, Catal. Brit. Fish. p. 30; Yarrell, Brit. Fishes (Ed. 3) ii, p. 207, c. fig. (*variety*).

Scribbled mackarel, Couch, Fish. Brit. Isles, ii, p. 84, pl. lxxxi, fig. 2 and ? pl. lxxx, fig. 2 (*variety*).

B. vii, D. 11-14/$\frac{1}{10\text{-}11}$ + V, P. 17, V. 1/5, A. 1/$\frac{1}{11}$ + V, C. 19, Vert. 14/17.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin $6\frac{1}{3}$, of pectoral fin $9\frac{1}{2}$, height of body $5\frac{1}{4}$ to $6\frac{1}{4}$, in the total length. *Eye*—with broad adipose lids, the posterior extending to over the hind third of the pupil and inferiorly being covered by the anterior which does not reach to the iris, and is attached by its lower edge to the sub-orbitals: diameter of eye 1/5 to 1/6 of the length of the head: $1\frac{1}{3}$ diameters apart: the length of the snout being equal to about one-third of that of the entire head. Jaws of almost the same length anteriorly: the maxilla, which is covered by the suborbital, reaches to beneath the middle of the orbit. Posterior limb of preopercle very oblique, causing the angle to appear somewhat produced. *Teeth*—in a single row of rather sharp ones in the jaws, in a deciduous patch on either side of the vomer, and in a single or double row on the palatines: a central row of teeth at the base of the tongue. *Fins*—dorsal commences at the beginning of the second third of the length of the body: spines weak, the second and third the longest, from thence they decrease to the last. Second dorsal low, and similar to the anal. Pectoral not quite half as long as the head: ventral one-fourth shorter than the pectoral. A single, short, pre-anal spine between the vent and the commencement of the anal fin. Caudal deeply forked. *Scales*—minute, about twenty-one rows between the lateral-line and base of the first dorsal fin: along the sides and lower surface of the abdomen, they become nearly indistinguishable. Several rows below the eyes passing across the cheek. *Lateral-line*—nearly straight. A keel along either side of the root of each lobe of the caudal fin. *Air-bladder*—absent. *Cœcal appendages*—numerous. *Colours*—the upper third of the body is of a beautiful green shot with blue, while the sides and abdomen are radiant with gold, purple, and silvery shades. About thirty-five V-shaped bands pass downwards from the back and terminate just below or on the lateral-line: a dark stripe, sometimes interrupted, goes from the base of the pectoral fin along the side a little distance below the lateral-line. A light yellow colour behind the eye. Fins dark, and generally with a black white-edged outer line. Or the body to just below the lateral-line, may be covered with small black spots or scribbled markings.

Donovan asserted that the males have straight transverse stripes, and the females undulated ones, the correctness of which I have been unable to verify. It has likewise been observed that the male has a more slender form and an elongated gill-cover.

Varieties.—The European forms of *Scomber* have been divided into (1) those possessing an air-bladder, and (2) such as are deficient in this organ. *Scomber*

pneumatophorus and *S. colias*, which may be varieties of a single species, are both provided with an air-bladder: whereas those which are without it have been described as *Scomber scomber*, Linn. *S. punctatus* and *S. scriptus*, Couch. On April 21st, 1880, I received from Mr. Dunn of Mevagissey, an example (figured plate xxxiii) of *S. punctatus*, a female 14 inches in length, with the ova not quite mature. D. $13/\frac{1}{11}$+v, P. 21, V. 1/5, A. $1/\frac{1}{11}$+v, C. 17. Its proportions are as in *S. scomber* and it has no air-bladder, in fact it is a variety in colour of the common species. I have not obtained *S. scriptus*, but it appears to be another variation in markings of the common mackerel, like which it is destitute of an air-bladder. Couch, plate lxxx, below the Spanish mackerel, *S. colias*, has figured what appears to be another variation in colour, and in which the eye was similar in size to *S. scomber*, while it also had no air-bladder. Mr. Dunn has drawn attention to the spotted and scribbled varieties being seldom if ever seen in the winter or spring. They come with the summer shoals.

Mr. Cornish observed that on May 14th, 1874, he came in the steamer from Scilly, bringing mackerel over for the London market, they were washed on board and "the result of my inspection is a strong opinion, that so far as outward differences are concerned, the distinction between the common mackerel, *Scomber scomber*, the dotted mackerel, *S. punctatus*, Couch, and the scribbled mackerel, *S. scriptus*, cannot be maintained, and I should include the Spanish mackerel, *S. colias*, in the list but for its size. In the lot which I watched, from 12,000 to 15,000 fish, there were fish of every grade of marking, and a large percentage having the sharp pointed head attributed by Couch to the Spanish mackerel. I have no doubt that I could have picked out four fish, each of which should answer precisely to the description of one of the four fish mentioned above, and differing each largely from the other three: but I could have supplied the gaps between them with variety after variety, until no one should be able to say where one species began and the other ended."* Mr. Dunn mentions some red-finned varieties which the Mevagissey fishermen carefully look for, as when they appear quantities of fish are usually off the coast.

Names.—*Mackerel*, formerly spelt *macquerelle*. *Rionnach*, pronounced *ronach*, Celtic, in Moray Firth (Gordon), *shiners*, young off North Coast. *Le Maquereau commun*, French. *Makreel*, Dutch. The term mackerel has rather improbably been supposed to have been derived from *macularius* or spotted.

Habits.—Mackerel are a gregarious wandering form of pelagic fishes which remain off our coasts throughout the year, and at certain seasons approach the shores in countless multitudes, either prior to, during, or after breeding: or else for predaceous purposes. Occasionally they forsake their usual haunts, thus from May to July they were formerly abundant at Yarmouth and Lowestoft, whereas now numbers come in with the herrings, having deferred their advent to a later period in the season; or they may even antedate their usual appearance, as will be remarked upon. Formerly, they were supposed to undertake long migrations annually from the north towards the south at one season and subsequently the reverse. Lacépède, on the authority of Admiral Pleville-Lepley, actually asserted that in some small and almost land-locked bays off Greenland, where the water is always clear and the bottom consists of soft mud, myriads of mackerel might be seen at the beginning of spring, with their heads inserted several inches into the mud, and their tails vertically elevated. He continued that in this manner and in a state of torpor they passed the winter, while during the first fifteen or twenty days after their reappearance they were affected by a sort of blindness and could be easily netted, but that subsequently they had to be captured by means of hooks and baits!

It is during the winter months or in the early period of the year, as January or February, that these fish usually commence to move from the deeper portions of the Atlantic towards the British coast, and in May or June large shoals of spawning fish appear to the south west of the Scilly Isles, some portion passing towards the Bristol or St. George's Channels, or Ireland in a north or north-

* Zoologist, 1874, p. 4037.

easterly direction, while the largest proportion go up the English Channel along the south coast of Britain. Mr. Dunn observes that they are seldom seen further up the English Channel than the Lizard off the British coast and Brittany off the French shores. The shoals which pass up the St. George's Channel rarely extending beyond Cork. Couch stated that in the early movement the sexes are often much divided, the males usually preceding the females in their migrations. But besides these large assemblages of breeding fishes there are shoals of mostly smaller ones which appear off the south coast according to the character of the season, increasing or lessening their distance from the shore as the temperature falls or rises. In mild seasons they are mostly caught first at Portsmouth, as in January or February, but Plymouth on an average is considered the earliest place to which they resort, and where they are taken from ten to thirty miles from land. On the Hampshire and Sussex coasts they are first taken in March, or sometimes even in February, while off Norfolk the greatest fisheries are in May and June. They also arrive in the Isle of Man in June. In the Moray Firth they appear in immense shoals about August (Gordon) and in the Orkneys during the last week in July (Low.) On January 28th, 1880, they appeared off Penzance, whereas the end of February is usually the time at which they may be expected: they extend their stay into June. The same phenomenon occurred further to the north, thus at Christiania some very fine ones were taken in April, although their usual time of arrival off the northern coast of Norway is not before the advent of warmer weather.

As already remarked, they may arrive long prior to their usual period, thus Couch observes that in 1818, 15,000 were taken at Mevagissey between February 1st and 12th: in 1842, two boats brought 18,000 into Plymouth, while in 1843, in the first week in February, from 20,000 to 30,000 were captured each night.

The period at which the arrival of these fish may be expected at any particular locality may be somewhat accurately computed, by ascertaining at what time they normally appear off certain points, and how long an interval generally occurs between their arrival at one place and their subsequent appearance at a more distant locality. The number of days they take in migrating from place to place is generally the same in different years.

The character of the season or the weather does not appear to be the only agent by which these fishes early migrations are ruled. But it has been remarked that a particular temperature or direction of wind has some connection with their swimming nearer to the surface or deeper in the water. Mr. Cornish (Zoologist, 1876, p. 4767) has remarked that about once in every eight or ten years they swarm into Mount's Bay: thus in August and September, 1875, at high water, they could be bailed out in buckets at the pier head.

In the spring the average size captured is smaller than it becomes during the autumnal and winter months, owing to some of the shoals being partly or entirely composed of young fish. Their course seems to be very erratic, rising to the surface and approaching the shore, or remaining at the bottom in deep water. But as the summer advances and their food enters sandy bays, then these fish follow and appear to have become exceedingly active. By the end of September or October, having spawned, the old ones retire to the Atlantic, in which migration they appear to be often accompanied by those which were hatched early in the season. Sometimes the half-grown fish retiring into deep water at the end of the year seem to be interrupted in their course, which causes them to remain off the coast during the winter months.

Their food is still a subject in which much remains to be investigated. Doubtless they prey upon members of the herring family and the fry of such forms as come in their way. Thus when the mackerel midge, which is the young of the Rockling, *Motella*, becomes abundant about the middle of May, these fishes congregate to feed upon them. At Mevagissey, Mr. Dunn has remarked that some small jelly-fishes (Medusæ?) about the size of a split pea, and of a dark green colour, appear after heavy rains, at night they are luminous. Mackerel prey upon them. Occasionally quantities of young of the dwarf

swimming crabs, *Portunus pusillus*, are taken among these fish, and upon which they are believed to have been feeding. They also feed upon minute creatures said to resemble sand-hoppers, which abound about February. In May, 1880, I opened a number of these fishes, from the south coast, and all had their stomachs full of ova on which they had evidently gorged themselves.

Mr. Smith* observes upon having kept some of these pelagic fish from June or July in the previous year in an aquarium, the size of which was eight feet by six, and in August two were yet alive. Still they are difficult to retain in confinement owing to their impatience of restriction and they injure themselves by dashing about, besides being very susceptible to atmospheric vicissitudes. Those captured earlier in the season in drift nets are not the best for this purpose, because coming from deeper water they are liable to injury while being meshed in the nets, or subsequently when being conveyed ashore: whereas later on they migrate into shallower places where seines are employed. The presence of fellow-captives of the same species which have been some time in confinement in the aquarium is found to exercise a great controlling power on the new comers, which for some time should be kept in the dark.

Pontoppidan relates how a Norwegian sailor was destroyed by a shoal of mackerel who surrounded him while bathing, carried him out to sea, and managed, while pushing him along, to so bite and nibble at their victim that his friends, with all their exertions, were scarcely able to get him alive into their boat, where he soon expired from exhaustion and loss of blood.

Ælian records how fishermen trained mackerel to act the character of decoys to shoals of their fellows whom they inveigled into their owners' nets: not content with this, he informs his readers that this faculty was continued to the descendant of their decoy fish for several generations.

Modes of capture.—As the January fish obtain a very high price, the fishermen seek the shoals in the earliest time of the year.† In the spring the Cornish boats proceed eastward for mackerel fishing but they net towards the west, thus meeting the shoals. The distance the boats proceed up the English Channel varies in different seasons, while the earliest fish may be expected furthest out to sea. The quantities captured are liable to great variations in different years, several good harvests may follow one after another, or the reverse may occur; likewise one set of boats may be making large catches while neighbouring ones are scarcely securing a fish. I have already alluded to there being two classes of mackerel: viz., the enormous May and June shoals that come for spawning and consist of large fish: and the more erratic or in-shore ones that do not appear to keep so well to stated times: the modes of capture of these two classes varies. The nets employed in the English Channel are for the in-shore or smaller forms, the mesh of which before being tanned averages from 27 to 28 half meshes to a yard: but those employed at the entrance of the channel for the spawning shoals average untanned from 21 to 22 half meshes to a yard.

Early in the spring numerous fishing boats, manned with from five to eight men each, assemble in Plymouth preparatory to the mackerel season, and for the purpose of trying their fortune in the English Channel with drift nets, which are shot of an evening and usually lifted after two or three hours, but shot again in the very early morning, the best time for carrying on this occupation having been found to be when daylight passes into darkness, or the night into the morning. The fishermen believe that at the commencement of the season the vision of these fishes is not so good as it becomes later on, when, however, it may be materially assisted by lighter days and moonlight nights. It has been remarked that drift nets are less productive during bright moonlight than when the nights are darker, as the fish are believed to perceive and avoid the net suspended for their capture. In darker weather, however, the mackerel force

* Zoologist, 1867, p. 917.

† On April 24th, 1880, a somewhat curious festival was celebrated on the Brighton beach The fishing fleet being about to start in search of mackerel, the annual custom of holding what is termed a "bending in" was observed, the chief feature being to keep open house around the boats where bread and cheese is gratuitously given to everyone who asks for it.—*Anglers' Note-book*, p. 129

their heads through the meshes beyond their gill openings which precludes their being again retracted. The modes of capture must vary with local circumstances but generally during the spring and autumn drift* nets only are employed, whereas in the summer, as towards the end of May in Cornwall, these fishes come nearer inland and seines are likewise used. The two may be also in operation at the same time, thus in the first week of July, 1880, both drift and seine fishermen were making large captures off the Cornish coast. At this period a man termed a huer is appointed to keep a look out for the appearance of the shoals of these fishes: on perceiving which, he signals to the fishermen who at once depart in the direction of the anticipated captures. Mr. R. Couch remarked in the Zoologist that some of the fishermen believe "that if from any cause the eastward migrations pass up mid-channel, the spring fish first appear on the eastern fishing grounds about Brighton, and spawn before they get so far west as the Cornish or Devonshire coasts: hence the eastern fishery is profitable while the western is a failure. If, on the contrary, they pass up at short distances from the shore, the eastern fishery is a failure and their boats come westwards to take the fish." (p. 1410.) The failure of the fishery, therefore, frequently depends upon the fishermen looking for the fish in a wrong direction, and thus they pass unnoticed. They do not rise to the surface during spring and autumn as they do in summer, so their presence has to be detected by nets and fishing, sometimes there are few near shore while they are abundant in the deep water. In September and October mackerel mostly retire to deeper waters, or separate into small shoals, rendering this mode of fishing useless. This, however, is very liable to vary, thus during the last week in November, 1880, drift nets were still being employed at Penzance and took large, fat, and well-flavoured mackerel by thousands a night, although usually catches of this sort do not occur after the beginning of June or before the end of February. Small mackerel are often captured until Christmas (Cornish).†

At Rye there is a large mackerel fishery, where fixed nets termed "kettle nets" are employed, each of which is a little over half-a-mile in length: the poles to which they are attached being twelve feet high, while each contains three chambers or bights. They commence being used on April 14th, and are continued until the end of November.

Droves of sea birds flying above and every now and then swooping down upon the fish, often give a good indication of where they are: the circling, screaming birds acting as detectives.

When mackerel are in small and divided companies, netting could not be remunerative, but hand-lining might be, and it has been observed that more proportionate success generally attends the employment of several lines used together, while several hooks are best on one line. Those captured by hooks and lines generally command a better price in the market than such as have been netted. Although these fish may be taken from a boat at anchor, the favourite time for fishing for mackerel with a bait is when there is a little ripple on the sea, and a light gale is blowing, termed a "mackerel breeze" by fishermen, which takes the boat along at a fair speed under sail, while should the sky be gloomy, so much the better. The plan adopted is termed *whiffing*, *railing*, *trailing*, or *plummeting*. Hand-lining may be carried on at any time during the day, as they appear to feed at all hours, but best in the morning and evening. The line is short but heavily weighted to a cone-shaped leaden plummet: a small line, termed the snood or snoozing, is attached to near the end of the leaded line on one side and terminates in the hook at the other: the bait or lask is wedge-shaped, the thick end being on the hook, while it should take on an undulating motion to resemble a fish.

Baits.—When *whiffing* or hand-lining for these fishes, natural baits may be employed, as a slip from the side of another mackerel's tail termed a lask, a cuttle fish, a thin rind of pork, or mud-worms. But besides the foregoing, any

* For a description of the various kinds of nets and how employed, see *Introduction*.

† The pilchard season of 1879 ran into January, 1880: while the mackerel season of 1880 commenced in the latter part of January, 1880 (T. Cornish).

glistening substance will attract them, as a pearl button, or Hearder's silver spinner which is an imitation fish fastened on to a silvered plate of copper, and mounted so as to spin freely on a piece of wire. A slip of white kid or a piece of red cloth have likewise been used with good effect; or stranger still, Ball found about two inches of the stem of a tobacco pipe, put on the line down to the hook, a novel and most successful bait. Fishermen also believe they can entice mackerel from the bottom by various eatable substances used when the boat is at anchor, as salted pilchards which, having become rancid, are beaten to a pulp and hung over the side of the boat in a basket from which little bits drop.

French mackerel vessels are of a larger capacity than those employed by British fishermen, carry a greater number of hands, and are frequently aided by steam power. The French seek the large shoals of spawning fish, and it is said not to be uncommon for one vessel to obtain upwards of £1000 worth of fish in a single season (while but few English boats are upwards of 40 tons burden, and Mr. Dunn estimates that £250 would be a very good return for the best of them). They takefish for salting, and consequently do not require to repair so rapidly to port. The captures are preserved on board and packed in the hold, and when the latter is full they return to France.*

Having now described the modes employed for capturing these fish, a few details are desirable to show their value when brought to market. Yarrell furnishes some interesting figures respecting what obtained during the first quarter of the present century. In May, 1807, the first Brighton boat-load sold at Billingsgate at forty guineas a hundred, or seven shillings each, computing six score to a hundred: this was the highest price ever reached in that market. The next boat-load produced but thirteen guineas a hundred. In 1808 mackerel became so plentiful in Dover that they were disposed of at sixty for a shilling: while in June the same year at Brighton, a net was so completely filled by them, that it was impossible to drag it ashore: the fish and net in the end sank together. In 1821, the value of the catches of sixteen Lowestoft boats on the 30th of June, amounted to £5252. In 1823, 1,420,000 of these fishes were taken at Yarmouth. In 1844, during October, the Mount's Bay fishermen took 1,400,000, which sold for about £4000. In May, 1868, 300,000 were netted one morning near the Scilly Isles. June, 1869, 10,000 a fortnight were secured at Weymouth, an event which had not occurred for thirty years. Couch gives the average price of mackerel for seven years as from £6 to £9 per thousand: and the numbers taken in a boat of rather less than the average size with drift nets, from 15,000 to 24,000. But it sometimes occurs that more than these may be taken in a single night; in fact, at Penzance drift nets have frequently brought 100 tons in a single night in May.

Breeding.—In the spring of the year the roe of the mackerel may be observed to be growing very fast, and in the south coast of Britain it seems to be shed about May or June. Sars remarks that it is deposited at some leagues from the shore and at the very surface of the waves, where a great quantity of these fishes may often be met with, engaged in spawning. The ova of these fishes shed in the Brighton Aquarium, has likewise been observed to float. A low temperature exercises great influence in postponing breeding, and fish in roe are occasionally seen even in winter. Harmer found 546,681 ova in a female 18 oz. weight, 430,800 in a second of 20 oz. weight, and 454,961 in a third of similar size, all having been captured in the month of June: while Bloch counted 540,000 in one he examined. Mackerel quickly recover from the effects of spawning.

Although this fish is generally a very rapid grower, such must greatly depend on whether suitable food abounds, or the reverse. At Mevagissey, where spawning occurs in May or June, young about three inches long, are plentiful in the bays about August and September, leaving for the deep sea in November, when they are from 6 to 7 inches in length, and reappearing the following June about 8 or 9

* Large quantities of mackerel are now imported in ice from Norway, commencing in the spring and continuing until the end of July.

inches long (Dunn). In fact, the young at the commencement of winter are small, and their growth is slow up to the following spring.

Hermaphrodites.—Couch observed upon having noticed these in the form of a lobe of roe lying between the usual pair of lobes of milt: while A. Malm likewise describes and figures such.

Diseases.—The nipper crab, *Polybius Henslowii*, which swims near the surface, has been known to kill mackerel. The Myxine, a form of sea lamprey, likewise bores into its flesh. Mr. Dunn was good enough to send me an example of a fish louse, *Rocinela dannoniensis*, which he took off a mackerel at Mevagissey, in September, 1879. He observed that some hundreds have been observed on these fish, and all he noticed or heard of were found clinging near the pectoral fin, except one which was imbedded near the vent. When half a mackerel is used as a bait, the lice will sometimes in a few minutes scoop out all the fish, leaving nothing but the skeleton and the skin.

As food.—Mackerel are much esteemed, the moderately sized more than the very large ones, but they taint very rapidly, as well as lose flavour when kept. Some prefer those captured during the autumn and winter months, while others like such as are in roe taken in May and June or even July. Those marked with a dark interrupted line along the side are said to be of inferior quality. Owing to the rapidity with which these fish decompose in hot weather, and the consequent deleterious results to consumers, vendors were permitted as early as 1698 to cry them through the streets of London on Sundays, an enactment which does not seem to have ever been repealed. The employment of steam carriers in the place of sailing vessels, and which take the captures from the various boats and convey them rapidly to market, has proved a great gain to all parties, and a boon to the general public. They are usually packed in boxes containing about fifty each for sending to market, ice being added. This fish was much relished by the Romans, because its internals furnished the precious *garum*, a sort of pickle which gave a high relish to their sauces, besides being medicinally employed, and was said at one time to sell for a sum which would be equivalent to £48 of our present money for two gallons of it.

Modes of cooking.—They may be boiled, and fennel or gooseberry sauce as well as melted butter is sent to table with them: they may be stuffed with forcemeat and baked: or split open, the backbone removed, and the fish fried in lard: they are likewise very good broiled whole or stewed with claret. Fillets of mackerel may be fried, broiled, boiled, or stewed in wine.

Habitat.—Extensively distributed in the northern and temperate seas of both hemispheres, and as far south as the Canary Isles. In the Mediterranean the fishery commences at the same time as in the north of Europe, or in the English Channel, or even earlier. They are taken in the Gulf of Lyons from April until August, and in Provence even in May, continuing sometimes until October. At Nice they are said to abound during the spring, and at Genoa are known as April fish. They extend their range into the Black Sea, and during the summer numbers are present, while those of various sizes appear all to breed: they are said not to be found in the Sea of Azof. These fish differ in size and taste not only with the seasons, but also the localities they inhabit: we find that they are finest in the English Channel. They are always few in the Baltic, although they occasionally occur off the coast of Sweden, as in 1851, but they were small, it taking about three to average one pound weight. Neither do they seem to be always esteemed, at least, in Amsterdam: and in the Mediterranean, as a rule, they are dry and inferior in flavour. In the Western Hemisphere they extend from Greenland to as far south as Cape Cod in Massachusets.

In the British Isles they are most abundant along the south coast, up the eastern shores to Norfolk and Suffolk, and also along the western counties. They appear off the Scottish coast late in the summer, as has been already alluded to under the head of *habits*. Their presence is often detected by large flocks of sea birds, which are swooping down and feeding on the fishes below them, and show the fishermen where they may be found.

In *Ireland* they are common round the coast, from Donegal and Antrim, down the east and along the south to Kerry, but are not so abundant along the west as along the east side of the island. Thompson observed in 1836 that in Newcastle, county Down, they were only taken at the latter end of August, while ten miles to the south they had appeared a month previously, this difference being of annual occurrence. The best fishing on the north-east coast commences about July. Rutty remarked that these fish arrive off Dublin in May, and continue for three months.

The ordinary size of mackerel for the table is from 14 to 16 inches in length. Buckland remarked that in the spring of 1879 he received one 18 inches long, and which weighed 2 lb. 11 oz. Mr. Cornish recorded one from Penzance $18\frac{1}{2}$ inches long, and 2 lb. 8 oz. in weight (Zoologist, 1876, p. 4931). Yarrell mentions one of $2\frac{1}{2}$ lb. taken at Poulton, in November, 1849, and an example 2 oz. more caught off Hastings in 1856.

2. Scomber colias, Plate XXXIV.

Κολιας, Arist. Hist. Anim. v, 9, viii, 13, ix, 2; Athen. iii, 118, 120, vii, 321.

? *Colias*, Pliny, xxxii, c. 11; Belon. p. 202; Rondel. viii, c. 8, p. 235, c. fig.; Salv. f. 242; Gesner, Aquat. p. 256; Aldrov. Pisc. p. 274; Jonston, lib. i, tit. iii, c. 3, punct. 6, p. 97. t. xxi, f. 11; Willugh. Ich. p. 182. *Colias Rondeletii*, Ray, p. 59.

Scomber colias, Gmel. Linn. p. 1329; Bl. Schn. p. 22; Lacép. iii, pp. 39, 40; Shaw, Zool. iv, p. 580; Turton, p. 100; Risso, Ich. Nice, p. 171, and Europ. Mérid. iii, p. 413; Cuv. and Val. viii, p. 39, pl. ccix; Yarrell, Brit. Fish. (Ed. 1) i, p. 131, c. fig. (Ed. 2) i, p. 148 (Ed. 3) ii, p. 204; Storer, Fish. Mass. p. 45; De Kay, New York Fauna, Fish. p. 104, pl. xi, f. 33; Lowe, Pro. Zool. Soc. 1850, p. 248; White, Catal. Brit. Fish. p. 30; Günther, Catal. ii, p. 361; Steind. S. B. Ak. Wien. lxxii, 1876, p. 81, and Ich. Span. u. Port. 1868, p. 2.

Scomber maculatus, Couch, Mag. Nat. Hist. v, p. 22, f. 8 (not Forster MSS.); Jenyns, Manual, p. 361; White, Catal. p. 30; Thompson, Ann. Nat. Hist. vii, p. 479, and Nat. Hist. Ireland, iv, p. 93.

Scomber diego, Ayres, Proc. Calif. Acad. Nat. Sc. i, 1857, p. 92.

Spanish mackarel, Couch, Fish. Brit. Isles, ii, p. 78, pl. lxxx.

B. vii, D $7/\frac{1}{12}$+V-VI, P. 21, V. 1/5, A. $\frac{1}{11}$+V-VI, C. 21.

Length of head 4 to $4\frac{1}{3}$, of caudal fin 6 to $6\frac{1}{2}$, height of body $4\frac{1}{2}$ to $5\frac{1}{2}$ in the total length. The thickness of the body equals about 2/3 of its height. *Eye*—diameter $3\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and 1 apart. The posterior adipose eyelid passes over the hind quarter of the pupil, and crossing the lower edge of the anterior lid is inserted into the suborbital ring of bones: the anterior lid does not reach so far as the pupil. *Teeth*—in the jaws in a single row: fine ones on the vomer and palatines, but none on the tongue. *Fins*—first dorsal rather high, its longest spine equalling the length of the interspace between the two dorsal fins. Pectoral about half as long as the head. *Scales*—those in the pectoral region are larger than the others on the body, where although they form a species of corselet, it is not so distinct as in some of the tunnies. *Air-bladder*—present. *Colours*—somewhat similar to what are observed in the common mackerel, more especially in its spotted variety, except that the lines which cross its back are usually less numerous. The dark colour of the back is continued below the lateral-line, so as to include almost the entire upper half of the body, while the abdomen has numerous large round or vertical blotches irregularly dispersed over it. A black shoulder spot extends to the base of the pectoral fin.

Varieties.—*Scomber pneumatophorus*, De la Roche, Ann. Mus. 1809, t. xiii, p. 334, Mém. p. 48; Cuv. and Val. viii, p. 36; Guichen. Explor. Alger. p. 56; Günther, Catal. ii, p. 359, is considered by Steindachner, and other excellent observers, to be a variety of this fish, which, if so, would possess from 7 to 10 dorsal spines and 11 or 12 dorsal rays. Personally I have not sufficient materials to examine

this question, but the example of each variety in my collection have the numbers recorded, otherwise the proportions of the two are very similar.

Names.—*Coly mackerel* and *Spanish mackerel*, the first taken from its Latin name, whereas the second is objectionable, this designation having been used for another species. Ray remarks, "The tunny-fish or Spanish mackrell. Hunc in *Mari Cornubiam* alluente captum *Pensantiæ* vidimus."

Habits.—Couch states that this species is not so active as the common mackerel, but is said to be equally voracious as a feeder. It comes irregularly off our coasts, but at Marseilles it appears at spring time, and at Nice in numbers during May and November.

As food.—Mr. Dunn observes that its flesh is softer and it decomposes more quickly than the common mackerel. It is found in Europe to be very inferior to the *Scomber scomber*, from which it may at once be known by its much larger eye: in fact, in the Mediterranean they are usually salted before being eaten. In Spain salted *colias* is said to obtain a good market, but in no other European country have they any considerable sale. On the other hand, De Kay asserts that at New York "they are excellent eating." Therefore, like the *Scomber scomber*, their taste may depend on locality.

Habitat.—In Europe they are found in the Mediterranean, wanderers straggling to the south coast of Great Britain. Lowe, l. c., recorded that in April, 1844, the market at Funchal, in Madeira, was plentifully supplied with these fishes for two or three successive days. They were said to have been brought from Porto Santo. In the Western Hemisphere they are found from Nova Scotia to Cape Hatteras.

This fish in certain seasons does not appear to be infrequent in Cornwall: according to Couch, three or four hundred are occasionally seen at a time. A number were recorded in 1850 off Brighton (Hussey, Zoologist, 1850, p. 2929). Edward thinks he recognized one example in Banffshire. Turton observes that they are found frequently in the weirs about Swansea but do not come in shoals.

In *Ireland* they have been recorded on hearsay by Thompson as occurring on the Connemara coast; it is said on the authority of Mr. McCalla that two species of mackerel are found there, and the second is supposed to be *S. colias*, while it is also termed Spanish mackerel: Mr. Nimmo subsequently stated to Mr. Thompson that the Spanish mackerel of Roundstone is the *Belone vulgaris*.

Valenciennes records them of 4 lb. weight and 16 inches in length: while De Kay observes that at New York, during August and September, he has seen examples of this fish nearly 2 feet long. I am indebted for the specimen figured to Professor Vinceguerra, of Genoa.

Genus II.—Orcynus (*Cuvier*), *Lütken.*

Branchiostegals seven: pseudobranchiæ present. Body oblong and somewhat compressed. Cleft of mouth deep. Small teeth on the jaws, vomer and palatine bones, none on the tongue. Two dorsal fins, the spines of the first weak: finlets posterior to the second dorsal and anal fins: no free spine before the anal fin. Scales small, covering the body, those on the anterior portion of the body forming a species of corselet. Lateral-line unarmed, a longitudinal keel along either side of the free portion of the tail. Air-bladder, when present, simple. Pyloric appendages numerous.

Geographical distribution.—Found in most tropical and temperate seas.

Fishes of this genus differ from the true mackerel, *Scomber*, in having a longitudinal keel along either side of the free portion of the tail, and the two dorsal fins being placed close together: while the corselet, which is commencing to be seen in *Scomber colias*, becomes now more developed in adults, and the pectoral fins are likewise elongated in examples which have attained to their full growth.

They are very voracious, and may be seen in shoals pursuing other fish on which they prey.

As food, they frequently occasion indigestion and diarrhœa when eaten fresh, but are more digestible when salted or otherwise prepared.

Davy in his "Physiological Researches," observes that he found the heat of the body of a tunny considerably higher than that of the surrounding water, caused by the quantity of red particles in its blood.

1. Orcynus thynnus, Plate XXXV.

Θύννος, Aristot. ii, c. 13, iv, c. 10, v, c. 9-11, vi, c. 17, viii, c. 2, 12, 13, 15, 19, 30, ix, c. 2; Ælian, ix, c. 42, xiii, c. 13, 16, 27, xv. c. 3, 5, 6; Athen. vii, pp. 122, 301, 316, 319; Oppian, Hal. ii, p. 48, iii, 620. Ορκύνος, Ælian, i, c. 40; Oppian, i, c. 8, ii, p. 59; Athen. vii, pp. 301, 315. Μελάνδρυς, Athen. vii, p. 315. *Thunnus*, Ovid, Hal. v, p. 98. *Thynnus*, Pliny, ix, c. 15; Strabo, Geogr. iii, p. 145, v, p. 223, and vii, p. 320 A. xii, p. 345 D. xvii, p. 834. *Orcynus*, Pliny, xxxii, c. 11; Gesner, p. 962, and Ed. 1598, f. 59, c. fig.; Aldrov. iii, c. 18, p. 314; Jonston, lib. i, t. 1, c. 2, Art. 1, t. iii, f. 4; Rondel. viii, c. 13, p. 249, c. fig. *Melandrys*, Pliny, ix, c. 15. *Thunnus sive Thynnus*, Belon. p. 108; Rondel. p. 241. *Tonno*, Salv. p. 123. *Thynnus*, Gesner, pp. 957, 967, 1148. *Tunny fish*, Willughby, p. 176, pl. M. 1, f. 3; Ray, p. 58. *Thunnus*, Schonev. p. 75. *Scomber*, Brünn. Pisc. Mass. p. 70, n. 86. *Tunny*, Pennant, Brit. Zool. (Ed. 1) iii, p. 266, pl. lii, (Ed. 2) iii, p. 360, pl. lxiii. *Scomber*, No. 2, Artedi, Genera, p. 31; Duhamel, ii, Sect. 7, c. 2; Cetti, Stor. Nat. di Sard. iii, p. 138; Laquat, Voy. p. 23.

Scomber thynnus, Linn. Syst. i, p. 493; Gronov. Zooph. No. 305; Bloch, t. lv; Gmel. Linn. p. 1330; Lacép. ii, p. 605; Bl. Schn. p. 21; Bonaterre, Ency. Ich. p. 139, pl. lviii, f. 228; Shaw, Zool. iv, p. 581; Donovan, Brit. Fish. i, pl. v; Turton, p. 101; Risso, Ich. Nice, p. 163; Scouler, Mag. Nat. Hist. 1833, vi, p. 529; Fleming, p. 218; Jenyns, p. 362; Martens, Reise nach Venedig. ii, p. 432.

Thynnus mediterraneus, Risso, Eur. Mérid. iii, p. 414; Collett, Norges Fiske, p. 44.

Thynnus vulgaris, Cuv. and Val. viii, p. 58, pl. ccx; Yarrell, Brit. Fish. (Ed. 1) i, p. 138, c. fig. (Ed. 2) i, p. 150 (Ed. 3) ii, p. 209; Cuvier, Règne Anim. Ill. Poiss. pl. xlv, f. 2; Storer, Fish. Mass. p. 47; Swainson, Fishes, ii. p. 238; Thompson, Ann. Nat. Hist. v, p. 9, and Nat. Hist. Ireland, iv, p. 94; De Kay, New York Fauna, Fishes, p. 105, pl. x, f. 28; Guichen. Explor. Sc. Algér. Poiss. p. 57; Steind. Ich. Span. u. Port. 1868, p. 7.

Thynnus Orientalis, Tem. and Schleg. Fauna Japon. p. 94.

Orcynus secundi-dorsalis (Storer) Gill. Amer. Fish. Report, 1873, p. 802.

Thynnus thynnus, White, Catal. Brit. Fish. p. 30; Günther, Catal. ii, p. 362, and Fische Godefroy Mus. Heft. v. December, 1876, p. 150.

Tunny, Couch, Fish. Brit. Isles, ii, p. 86, pl. lxxxii.

Orcynus thynnus, Lütken, Spolia Atlantica, 1880, p. 460.

Of moderate age.

Thynnus coretta, Cuv. and Val. viii, p. 102; Günther, Catal. ii, p. 363.

Young.

Ancicoti (? Alicorti), Duhamel, Pêches, Sect. vii, p. 205, pl. vii, f. 5.

Thynnus brachypterus, Cuv. and Val. viii, p. 98, pl. ccxi; Cuvier, Règne Anim. Ill. Poiss. pl. xlvi, f. 2; Günther, Catal. ii, p. 363.

Short-finned Tunny, Couch, Fish. Brit. Isles, iv, p. 425, pl. lxxxii*; Dunn, Journ. Roy. Inst. Corn. xxii.

B. vii, D. 13-14/$\frac{1-2}{13}$+VIII-IX, P. 31, V. 1/5, A. $\frac{2}{12}$+VII-VIII, C. 32-35, Vert. 16/23.

Length of head from $3\frac{1}{2}$ to 4, of caudal fin $5\frac{3}{4}$ to 6, height of body 4 to $4\frac{1}{4}$ in the total length. *Eye*—with an adipose lid having a circular opening, in adults the diameter is about 1/7 of the length of the head, while the distance from the eye to the end of the snout equals 1/3 of the length of the head. Lower jaw slightly the longer: the maxilla reaches to beneath the front edge of the eye. *Teeth*—a single row of small ones in either jaw, a few on the vomer and in a band on the palatines: none on the tongue. *Fins*—the pectoral scimitar-shaped, and varying in size with age. In the *adult* it is about $5\frac{1}{2}$ times in the total length of the fish: when a little younger, *O. coretta*, it is about $5\frac{1}{2}$ in the total length of the fish: whereas in the young, *O. brachypterus*, it is not more than 1/7 to 1/8. The first dorsal fin reaches about to the origin of the second, while the anal commences under the first free dorsal ray. *Scales*—cover the entire body, in the adult forming a very distinct corselet which sends backwards three prolongations. The superior passes along the base of the first dorsal fin: the central one is continued along the middle of the side, and in a groove in it rests the upper edge of the pectoral fin: while the inferior passes along the lower margin of the abdomen to a little beyond the termination of the ventral fin. In young examples the corselet is not so well developed, neither are the posterior prolongations so marked. *Air-bladder*—present.† *Colours*—back dark blue, almost black in adults, but having some stripes in the young: gray along the sides and white beneath. The sides are reticulated with fine gray lines, enclosing oval or round spaces. The corselet is rather lighter than the contiguous parts. Jaws dashed with pink. First dorsal fin dusky: the second and the anal pinkish, shaded with gray. Pectoral and ventral dusky, the first with a white posterior edge. Caudal dusky. The younger fish are the lightest coloured.

Varieties.—The tunny has had many names conferred upon it, due to the considerable modifications which it undergoes during its transformation from extreme youth to old age.

Names.—Pennant observed that on the coast of Scotland they were termed *Mackrelsture*, derived from the generic name of "mackerel," and the Norwegian word *stœrie* or great. *Tunny* has been considered a derivation respecting its rapidity of movements, or else that the term is of Hebrew or Phœnician origin, in allusion to its great size. *Thon* in olden times signifying any large inhabitant of the sea, or even the crocodile of the rivers. Aristotle recorded tunnies up to 1200 pounds weight, and Belonius states that in 1665 an example was taken off the Spanish coast measuring 32 feet in length and 16 in girth.

These fishes have been known in various places by different names, in accordance with their size, thus along the shores of the Black Sea the very young have obtained the designation of *auxid*, which signifies such from the time of extrusion from the egg until their first leaving the Euxine. The semi-adults are termed *pelamis*, which covers the time until their return the succeeding spring. The very large ones go by the name of *orcynus*. But as the same term is differently employed in different localities, an enumeration of names becomes of but little practical use. *Le Thon commun*, French.

† See a detailed description by H. Malm in his "Fauna of Bohusläu," and for the anatomy of the fish see Cuv. and Val. viii, pp. 63-69.

Habits.—They are generally considered as very timorous and easily frightened: for example, it is recorded that due to the earthquake which overthrew Lisbon in 1755, some alteration was occasioned in the character or conformation of the coast which has caused these fishes ever since to prefer the African shore. In Cornwall they mostly arrive in August, with the pilchards, or even earlier as July, and continue until the end of October or even into November. They pursue smaller fishes with great rapidity, and seem especially pleased when among pilchards, *Clupea pilchardus*, the skipper, *Esox saurus*, or the herring, *Clupea harengus*, and have even been observed to spring after the skipper as it jumps out of the sea to try and avoid its foe. But as the winter sets in, they appear to become inactive, reviving again the succeeding spring. It has been surmised that the large and solitary tunnies, which are occasionally found off our coast, are such as for some cause have parted company from others of their kind. It may be that having outlived the influence of sex, they have wearied of the further society of their fellows: or else that, like the rogue elephants, they have been expelled. Smaller tunnies are observed in limited companies off our coasts, being occasionally seen in Cornwall, and have been captured in herring nets at Yarmouth.*

That tunnies, similarly to their relations the common mackerel, undertake periodical migrations has been abundantly proved, but that all do so or that their extent is as great as was formerly supposed is open to question. They were believed to congregate in the Atlantic, and passing the Spanish coast to enter the Mediterranean in immense shoals, continuing their course on to the Black Sea in order to deposit their spawn there, while in this migration they rarely passed far from the coast. Diminished in numbers, they enter the Bosphorus, where, Pliny observed, that apparently alarmed at the presence of a white rock, they then cross to the opposite side termed the "Golden Horn," reputed to have received its name from the wealth which these fishes bring. When the time arrives for their leaving the Black Sea, they await a north wind and pass out at the opposite side to the one on which they entered. These interesting accounts of how the Bosphorus is passed are now stated to be fictitious. Off Spain these fishes arrive in three distinct batches, the first being composed of large individuals weighing four to five hundredweight, the second of such as are from two to three hundredweight, and the third smaller. As was remarked above as occurring in the common mackerel, those of different ages are apt to keep in companies. At Cadiz they are captured going towards the Mediterranean, but not on their return, whereas at Gibraltar and Tarifa they are fished for both coming and returning, the fishes at the first period being the largest and the best. While at Ceuta, on the opposite coast, they are rare, being taken on arrival but not while returning from the Mediterranean. Duhamel observes that they arrive in May and stay until the end of June in Corsica, Sardinia, Catalonia, and Sicily, but he likewise remarks that they fish for them in Catalonia until October, the late catches perhaps being returning fish. At Agde in the Gulf of Lyons, they are taken from April until September, and in Provence from June until September: while in the intermediate locality of Ciotat at the mouth of the Rhone, the first fishery is from their arrival in March until July 15th, after which date until October, the returning fishes are said to be taken in large numbers. In the not far distant locality of Cassis, they capture these fishes in November until the end of December, showing that some at least most probably remain in the Mediterranean, to the depths of which sea many must retire during the winter months.

Modes of capture.—Off the Cornish coast the tunny is mostly taken in mackerel or pilchard drift nets, or accidentally when fishing for herring or other species of fish. Its presence being more or less accidental and its value inconsiderable, it can only be said to be accidentally captured.

But in some parts of the Mediterranean, more especially at either extremity of that sea, tunny fisheries have been carried on from almost immemorial ages.

* Some authorities have looked upon the small tunnies taken off Yarmouth as bonitos.

Some authors have referred their commencement prior to the historic flood: others have credited Tubal Cain with having first employed boats and manufactured hooks for this purpose. The Phœnicians are said to have established tunny fisheries in Spain. Herodotus, B.C. 550, alludes to nets employed for taking this fish, and Ælian, how a watch tower was erected in an elevated situation to enable a watchman or huer to keep a look out for the advent of the tunnies. When perceived, he warned the fishermen, and likewise gave notice as to the way the shoal was heading. Much the same procedure continues to the present time, and on the watchman giving the alarm, numerous boats at once proceed to sea, the fishermen being under the orders of a chief, who directs them how to surround the fishes with a long net constructed of several pieces, which are severally joined together. As they draw in closer, more nets are added and the affrighted fish driven to where their destruction becomes easy. These may be stationary nets, having a cone-shaped tunnel to receive them, or large enclosures constructed of nets (see Introduction). In the Black Sea the greatest captures are made as the tunnies pass the Bosphorus.

Baits.—Although some authors assert that these fish do not take a bait, this cannot be invariably the case. Pennant observed that they did in his time: and in localities where they are numerous, an imitation fish proves a good lure.

Breeding.—Off Sicily, according to the Duke d'Ossada, these fish arrive in April or early in May with the ova undeveloped, but they rapidly grow and are deposited after the middle of June. In July the young are said to weigh $1\frac{1}{2}$ oz.: in August, 4 oz.: in October, 30 oz.

As food.—When quite fresh, if not above about 30 lb. in weight, the flesh is tolerable, its colour before being cooked somewhat resembles beef, but it becomes paler when boiled. Some consider its flavour between that of the salmon and the mackerel, but inferior to both. Others have compared the firmness of its flesh to that of the sturgeon, but considered its flavour to be superior. They may be used for soup, as ragouts, or plain fried or boiled. In France pies are made of tunny which are celebrated all over that country. *Thon mariné* is this fish preserved in oil with salt, and which is eaten cold like pickled salmon. The eggs also are prepared with salt.

In Pliny's time tunnies were cut into pieces, the shoulder, neck, and abdomen being most esteemed when eaten quite fresh, but even then they occasionally gave rise to much flatulence. The remainder of the fish was preserved in salt. The portions, which somewhat resembled black oaken boards, were termed *melandrya.* The tail part was that least esteemed. Younger ones were cut into cubical pieces and termed *cybium*, or small cubes. The shoulders formed the *clidium:* the *auchenia* was from the nape of the neck: while the *horeum* or *ureum* was believed to be the tail part, but these terms appear to have been differently used in distant localities. The tunnies of Spain and Sardinia were considered by the Romans as more tender and better tasted than those from Constantinople, this was attributed to the food being superior, and the further they travelled from these countries towards the column of Hercules the poorer they were said to become.

Habitat.—From the North Atlantic, extending into the Mediterranean and the Black Sea, along the British coasts and have been captured off Sweden, while the British Museum has received an example from Tasmania, in the South Pacific, rendering it probable that their range is more extensive than is at present known. In the Western Hemisphere they are occasionally seen in Newfoundland, and sometimes specimens of large size are washed up dead, especially after severe gales (Saxby, Zoologist, 1871, p. 2553). They extend down North America to so far south as Florida and even into the Carribean Sea, and Poey enumerates the various stages as distinct species all belonging to the Cuban Fauna.

In Britain they have been taken in the vicinity of the islands on the north and west coast of Scotland, while off Banffshire several have been captured from time to time, and a very large one in a salmon net at Portsey. This last measured 9 feet in length and 6 in girth (Edward). They have been recorded off the Norfolk coast where a large one came ashore (Gatcombe, Zool. 1877, p. 27). In the Norwich Museum is one 42 inches in length, believed to have been

secured off the Suffolk coast, near Southwold. A large one likewise came ashore off the Kent coast in 1880, while these fish are said by Mr. R. Couch to be common a few miles from shore around the Scilly Isles, Cape Cornwall, Lands End, Tol-pedw-penwith, to the Lizard; less so eastwards, but still occasionally found on the Devonshire coast, until about August, when they leave in a south-westerly direction.

In Ireland, Dr. Jacob obtained one 8 feet 3 inches long, off Dublin Bay, in the autumn of 1841, and which weighed fully 300 lb.

Occasional notices of the capture of large examples of this fish occur in natural history works. Pennant records a specimen weighing 460 lb. taken at Inverary in 1769. In 1801, three were taken off Margate, being said to be the first record of tunnies so far north on the English coast. In July, 1831, an example 9 feet long was taken at Gairloch, nearly opposite Greenock, it was in pursuit of herrings. 1840 they were abundant off Cornwall, and some weighed 80 lb.: 1850, they were common in the Moray Firth, one captured was 9 feet long, while another killed near Inverness was 5 feet (Gordon, Zool. 1852, p. 3459). In March, 1851, one weighing 316 lb. was taken off Dartmouth. In September, 1853, one said to be about 60 stone or 480 lb. weight was stranded in Tees Bay (Hogg, An. Nat. Hist. 2, 1855, xvi, p 213). In September, 1868, an example, measuring 8 feet 9 inches, was taken at Dawlish, in Devonshire, it weighed between 3 and 4 cwt.: in November, the same year, one weighing 5 cwt. was secured in the Firth of Forth. On October 6th, 1870, one 6 feet 9 inches long was taken at Yarmouth. July 22nd, 1873, one 9 feet long near Plymouth: November, 1876, one 9 feet 4 inches at Bacton. In May, 1880, the cranium of one, 10 inches across, was found off Margate: it must have belonged to a fish fully 7 feet long, and which probably weighed about 500 lb.

But the foregoing are by no means the largest recorded. Storer mentions one taken near Cape Ann, in America, weighing 1000 lb. While in Sardinia tunnies under 100 lb. weight are termed *scampirro:* from 1 to 300 lb. *mezzo-tonno*, "half-tunny." They frequently attain 1000 lb., and Cetti asserts that they run to 1800 lb.

The figure is from an example in the National collection.

2. Orcynus germo, Plate XXXVI.

? Albacore, Sloane, Voy. Jamaica, 1707, i, p. 28, pl. i, f. 1.

Alilonghi, Duhamel, Pêches, ii, Sect. vii, pp. 203, 207; Cetti, Nat. Hist. Sard. iii, p. 191.

Scomber alatunga, Gmel. Linn. p. 1330; Walb. Artedi, iii, p. 222; Lacép. iii, p. 21; Shaw, Zool. iv, p. 590.

Scomber germo, Lacép. ii, p. 598 and iii, p. 1; Bennett, Whaling Voyage, ii, p. 278.

Orcynus alalonga, Risso, Eur. Mérid. iii, p. 419: Swainson, Fishes, ii, p. 238; Couch, Zoologist, 1846, p. 1413, c. fig.; Scott, Ann. and Mag. Nat. Hist. (3) 1865, xvi, p. 268.

Thynnus alalonga, Cuv. and Val. viii, p. 120, pl. ccxv; Cuv. Règne Anim. Ill. Poiss. pl. xlvii, f. 1; White, Catal. Brit. Fish. p. 31; Yarrell, Brit. Fish. Second Supp. p. 14, c. fig. (Ed. 3) ii, p. 220, c. fig.; Lowe, Trans. Zool. Soc. iii, p. 4, and Pro. Zool. Soc. 1839, p. 78; Günther, Catal. ii, p. 366; Thompson, Ann. and Mag. Nat. Hist. (3) 1861, p. 340.

Thynnus Pacificus and *argenti-vittatus*, Cuv. and Val. viii, pp. 133, 134; Günther, Catal. ii, p. 366.

Thynnus balteatus, Cuv. and Val. viii, p. 136.

? Auxis Sloanii, Cuv. and Val. viii, p. 148.

Thynnus albacora, Lowe, Proc. Zool. Soc. 1839, p. 77, and Trans. Zool. Soc. iii, p. 4; Günther, Catal. ii, p. 365.

Thynnus macropterus and *sibi*, Temm. and Schleg. Fauna Japon. Poiss. pp. 97, 98, pl. l and li; Bleeker, Verh. Bat. Gen. xxiv, Makr. p. 37.

Long-finned tunny, R. Q. Couch, Zoologist, p. 1413, c. fig.

Germon, J. Couch, Fish. Brit. Isles, ii, p. 100, pl. lxxxiv.

Thynnus germo, Steind. S. B. Ak. Wien. 1876, p. 151, pl. xcvi; Günther, Fish. Gode. Mus. Heft. xi, Dec. 1876, p. 151, t. xcvi (scaling incorrect).

Orcynus germo, Lütken, Spolia Atlant. p. 187, t. iii, fig. 1, 2.

B. vii, D. $14/\frac{3}{12}$ + VII-VIII, P. 37, V. 1/5, A. $\frac{3}{12}$ + VIII-IX, C. 35, Vert. 40.

Length of head $3\frac{1}{2}$ to 4, of caudal fin 5, height of body $4\frac{1}{2}$ in the total length. *Eye*—diameter $4\frac{1}{2}$ to 5 in the length of the head, $1\frac{1}{2}$ to 2 diameters from the end of the snout. Lower jaw the longer: the maxilla reaches posteriorly to beneath the front edge or first third of the eye. *Teeth*—a row in the jaws, also present on the vomer, the palatines, and on the tongue. *Fins*—this species is distinguished by the great length of its sickle-shaped pectoral fin which is situated in the middle of the depth of the body: in the adult it equals about one-third of the total length of the fish, but as in the common tunny so in the germon it has been ascertained that the comparative length of this fin increases with the age of the fish. Dr. Lütken has figured in *Spolia Atlantica*, t. iii, f. 2 (see plate xxxvi), at thrice its natural size, one which measured 4/10 of an inch in length, and in which the pectoral fin was only one-eighth of the total length. The ventrals are placed close together, separated by a fine scale, which gives the appearance of an additional ray. Dr. Scott states that the Exe example had 8 finlets above and 7 below. *Cœcal appendages*—numerous. *Scales*—somewhat similar to what exist in *O. thynnus:* the groove for the reception of the pectoral fin is well marked, but the corselet is much more obscure. *Colours*—very dark blue along the back, becoming silvery on the sides and beneath. Occasionally dark parallel longitudinal lines pass along the sides of the body. Fins dark.

In the *young* there are strong spines at the angle of the preopercle, the posterior edge of which is also serrated.

The various stages of this fishes growth have been named much as follows. *Adult*, with pectoral fins reaching to beyond the termination of the second dorsal, *Orcynus alatunga* and *O. alalonga*. The body one-fourth higher than in adults, *O. pacificus*. Pectorals slightly shorter, being $3\frac{1}{2}$ in the total length, *O. argenti-vittatus:* a little shorter still, or 4 in the total length, *O. balteatus* and *O. macropterus*.

Names.—Germon or *long-finned tunny:* the first is said to be a corruption of *War-man* in use at the Ile d'Yeu, when the English were masters of Guienne and Poictou, and referring most probably to its habits of warfare among other fishes: *Albacore*. *Hegalalonchia* is its Basque name, and signifies "long-winged," while the usual term among French sailors of *longue-oreille* or "long-eared," also refers to the extent of its pectoral fins.

Habits.—These fishes appear to have much the same habits as the common tunny, and are equally voracious. They arrive in the Bay of Biscay sometimes as early as May, but more commonly in June, and remain until October, and are usually about two months later than the *O. thynnus*. The germon preys upon mullets, pilchards, mackerel, and other fish of gregarious habits, and M. d'Orbigny has found flying-fishes in their stomachs.

Bennett observes that ships when cruising slowly in the Pacific Ocean are usually attended by myriads of these fish for many successive months, but a few days rapid sailing is sufficient to get rid of them; they only take a bait while the vessel is moving. They follow the shark in shoals, and annoy it in the same manner as smaller birds do those of a larger and predacious kind, as the hawk or owl. He considered they came to the ship for protection against their chief enemy the sword-fish. "They are very voracious and miscellaneous feeders. Flying-fish, calmars, and small shoal fish are their more natural food: though they do not refuse the animal offal from a ship. Among the other food contained in their maw, we have found small ostracions, file-fish, sucking-fish, janthina shells, and pelagic crabs. In one instance a small bonito, and in a second a dolphin eight inches long, and a paper nautilus shell containing its sepia tenant. It was often amusing to watch an albacore pursuing a flying-fish, and to mark the precision with which it swam beneath the feeble aeronaut, keeping him

steadily in view, and preparing to seize him at the moment of his descent. But this the flying-fish would often elude by instantaneously renewing its leap, and not unfrequently escaped by extreme agility."

The example described by Dr. Scott was taken three miles up the Exe, where it had got entangled among some palings, which had been driven into the river about a foot from the edge, where a kind of quay had been made, and which formed a *cul-de-sac*. Into this the fish got: and so violent were its struggles to get out, that it drew the attention of some workmen who were at a little distance, when one of them got his gun and shot it. The efforts to free itself by shaking the palings were described as like the strength of two men.

Means of capture.—They are said to take baits only when at great depths, and to refuse them if at or near the surface: a cloudy sky and a mackerel breeze are opportune for this fishing, while the fishery is during July and August. Cuvier observes that when once a shoal of these fishes has been discovered, the fishermen follow them through the entire season.

Baits.—Will take any artificial substance resembling a fish trailing through the water, but when hooked are very strong. M. de la Moriniere says that the fishermen of Ile d'Yeu commence in the south of the Bay of Biscay, opposite St. Sebastian, and follow the fish as they migrate towards the north of Belleisle capturing from 13,000 to 14,000 of a season. Their lines are 80 fathoms in length and salted-eel is considered the best bait, but a scrap of white or blue cloth or a piece of earthenware or tin cut into the form of a pilchard is often sufficiently attractive.

As food.—It is found in the Bay of Biscay, and during the best season or in July and August, its flesh is whiter and more delicate than that of the tunny, whereas both anterior to this time and subsequently it is inferior.

Habitat.—Mediterranean, and extending in the Atlantic to Madeira and the Cape of Good Hope. Is common along the south coasts of Europe, and only a few stragglers have been recorded in Devonshire and Cornwall. Van Bemmelen, however, includes this species among his list of those found in Holland. It has been taken twice in Mount's Bay, in Cornwall, in mackerel seines, the last of these two in 1846. In March, 1861, an example 33 inches long was captured at Portland and sent to the British Museum (W. Thompson): in 1865, on August 26th, one 24 inches long to the base of the caudal fin, and 12 lbs. weight, was killed on the Devonshire coast, a little way up the River Exe, about three miles from its mouth, and at about half-tide (Scott l. c.).

The example figured is one in the national collection and was brought from the Cape of Good Hope. The figure of the young is an outline of that by Professor Lütken l. c. given three times the natural size.

Genus III.—Thynnus (*Cuvier*), *Lütken.*

Thynnichthys, Giglioli.

Branchiostegals seven: pseudobranchiæ present. Body oblong and somewhat compressed. Cleft of mouth deep. Small teeth on the jaws and palatine bones, but none on the vomer. Two dorsal fins with a very short space between them, the spines of the first weak: finlets behind the second dorsal and anal. Scales small, forming a corselet in the anterior portion of the body, but scaleless posteriorly. Lateral line unarmed: a longitudinal keel along either side of the free portion of the tail. Air-bladder, when present, simple. Pyloric appendages numerous.

This genus is composed of the smaller tunnies, which differ from the larger forms, *Orcynus*, in the vomer being toothless, and their having no scales outside the corselet: while irrespective of this, they possess a special development in the form of a net, or trellis, of a portion of the abdominal part of the vertebral column, between the vertebræ properly so-called, and the hæmapophyses, as has been described by Cuvier.

Although only one species of this genus, viz., *Thynnus pelamys*, has been recorded from the British seas, it is by no means improbable that others, as *T. thunnina*, may likewise be occasional visitors, for it has been captured more than once off Denmark, which locality it could scarcely have reached without passing our shores.

Geographical distribution.—From the seas of Northern Europe throughout those of temperate and tropical regions.

Thynnus pelamys, Plate XXXVII.

Renard, i, 20, 113; Osbeck, Reise, p. 87; Leguat, Voy. p. 21, c. fig.; Funnel, Voy. Dampier, p. 158, f. 32; Dutertre, Hist. Antilles, ii, p. 214, p. 295, c. fig. *Variletta*, Humbolt, Obs. Zool. ii, p. 190. *Thunnus*, Jonston, De Pisc. lib. i, tit. i, c. 2, Art. p. 12, t. iii, f. 2.

Scomber pelamis, Linn. Syst. Nat. i, p. 492; Bl. Schn. p. 23; Bonnaterre, Enc. Ich. p. 139; Gmel. Linn. p. 1330; Bennett, Whaling Voyage, ii, p. 281; De la Roche, Ann. Mus. xiii, p. 315; Shaw, Zool. iv, p. 588; Scouler, Mag. Nat. Hist. vi, 1833, p. 529; ? Risso, Ich. Nice, p. 167; Thompson, Proc. Zool. Soc. 1835, p. 80; Jenyns, Manual Brit. Vert. p. 363.

Scomber pelamides, Lacép. iii, p. 14, ii, pl. xx, f. 2.

Thynnus pelamys, Cuv. and Val. viii, p. 113, pl. ccxiv; Temm. and Schleg. Fauna Japon. Poiss. p. 96, pl. xlix; Rich. Ich. China, p. 267; Cuv. Règne Anim. Ill. Poiss. pl. xlvii, f. 2; Bleeker, Amboina, pl. 41; Yarrell, Brit. Fish. (Ed. 2) i, p. 157, c. fig. (Ed. 3) ii, p. 215; Parnell, Fish. Firth of Forth, p. 53; White, Catal. Brit. Fish. p. 31; Thompson, Nat. Hist. Ireland, iv, p. 94; Günther, Catal. ii, p. 364; Steind. Ich. Span. u. Port. 1868, p. 7; A. Malm, Œfv. Ak. Förk. 1875, No. 7; Poey, Ann. Soc. Esp. 1875, iv, p. 145; Day, Fishes of India, pt. ii, 1875, p. 252; McIntosh, Fish. St. Andrew's, p. 173; Winther, Prod. Ich. Dan. Mar. 1879, p. 14; Moreau, Hist. Nat. Poissons de la France, 1881, ii, p. 419.

Thynnus vagans, Lesson, Voy. Coq. Zool ii, p. 162, pl. xxxii.

Bonito, Couch, Fish. Brit. Isles, ii, p. 97, pl. lxxxiii.

B. vii, D. 13-15/$\frac{1}{12\text{-}13}$ + VIII, P. 27, V. 1/5, A. $\frac{2}{12}$ + VII, C. 35.

Length of head $3\frac{1}{2}$ to 4, of pectoral fin 6 to 8, height of body $3\frac{1}{4}$ to 4 in the total length. *Eye*—diameter 5 to 6 in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and also apart. The posterior margin of the preopercle is 3/5 the length of its lower limb. Snout pointed: the lower jaw the longer: the posterior extremity of the maxilla reaches to beneath the middle of the eye. *Teeth*—in a single row in the jaws, present on the palatines but absent from the vomer. *Fins*—dorsal spines of moderate strength, the first being strong, two-thirds the height of the body, and nearly twice as high as the rays of the

second dorsal. The pectoral in adults extends to beneath the tenth dorsal spine. Anal similar to the second dorsal, and commences on a vertical line behind its last ray. Caudal with pointed lobes. *Scales*—anteriorly form a corselet, which reaches from the base of the pectoral fin along the whole length of that of the first dorsal: behind this corselet the body is destitute of scales *Air-bladder*—stated to have been absent in Couch's example. *Colours*—back bluish, becoming silvery on the sides and beneath. Four, five, or even six concave, longitudinal, dark, bluish bands pass along the side of the body and abdomen, ending posteriorly on the lateral-line or close to the finlets.

Although Risso describes this fish pretty accurately as to colour and the number of spines and rays, it is questionable whether some error has not occurred, as he stated it to be common at Nice, whereas it is very rare in the Mediterranean. He observes that the body "is covered with small pentagonal scales," a definition applicable to *Pelamys sarda* (see page 102), with which he appears to have confused it.

Names.—Bonito. Striped-bellied-tunny.

Habits.—Although mostly observed in the open seas, they appear to be somewhat of surface swimmers, while they are generally seen in shoals of from twenty to thirty. They may be witnessed in the tropics pursuing the flying-fish, and resemble the tunnies in their propensity for consuming other forms. Lesson found a *Scombresox* in the stomach of one, and Commerson discovered small shells.

Breeding.—Couch remarks upon having procured a female full of roe in the month of July.

Diseases.—It is tormented, as are also other tunnies, by several species of intestinal worms.

As food.—Its properties appear to vary: Osbeck thought it dry, as did also Dussumier: but Commerson appears to have approved of it. Personally, I have eaten this fish when rounding the Cape of Good Hope and found it a little dry. Occasionally it causes colic and diarrhœa.

Habitat.—This fish is chiefly a resident of the open seas, more especially the tropical and warmer portions of the Atlantic, Indian, and Pacific Oceans. In Europe it has been obtained off Scandinavia and Denmark, also along the British coasts, the Canaries, and beyond. Although Dussumier brought examples from India I failed to obtain them there, but *Thynnus thunnina* was at certain seasons locally common.

Stewart (Elements Nat. Hist. i, p. 363) remarks that the "bonito" "has been taken though rarely in the Firth of Forth." In July, 1832, one was captured in the Firth of Clyde (Scouler, Mag. Nat. Hist. vi, 1833, p. 529) and purchased for the Andersonian Institute of Glasgow. But Jenyns observes that it is doubtful if this species be intended or the *Pelamys sarda.* In July, 1873, an example, 3 feet long, was procured by Dr. Moir, of St. Andrew's, from a salmon net, at the mouth of the Kenley Burn (Walker, Scot. Nat. January, 1874). Couch alludes to an example secured at Whitehaven in Cumberland. In September, 1876, one, 20½ inches long, was recorded as having been taken in a trammel net at Catwater, Plymouth, while a few larger ones are said also to have been captured there (Gatcombe, Zool. 1877, p. 27). In August, 1880, one, 2 feet long, which weighed 6¾ lb., was secured at Hawgill, Solway Forth.

Ireland.—One was taken near Wexford, 29 inches long, and sent to the Royal Dublin Society. Dr. Harvey also records one from Kinsale: in 1849, another was taken at Bennett's Court, South of Ireland, and sent to Yarrell.

The example figured is stuffed, and from the Cape seas. Yarrell's largest specimen appears to have been 33 inches in length, and was perhaps from Cork.

Genus IV.—Pelamys, *Cuvier and Valenciennes.*

Branchiostegals seven: pseudobranchiæ present. Body oblong, and rather elongated. Cleft of mouth deep. Rather strong teeth in the jaws, teeth also on the palatines but none on the vomer. Two dorsal fins, the first, which consists of rather weak spines, continued almost to the base of the second: six to nine finlets behind the second dorsal and anal fins. Scales small, forming a corselet in the anterior region of the body, which is also finely scaled posteriorly. Lateral-line unarmed: a longitudinal keel along either side of the free portion of the tail. Air-bladder absent. Pyloric appendages dentritical.

Geographical distribution.—From the seas of Northern Europe throughout those of temperate and tropical regions.

Pelamys sarda, Plate XXXVIII.

Amia, Rondel. viii, c. 9, p. 238, c. fig; Gesner, 1598, f. 60, c. fig. *Sarda*, Rondel. viii, c. 12, p. 248, c. fig. Gesner, 1598, f. 59, c. fig. (*Young*). *Pelamys*, Salviani, f. 123, c. fig.: Belon. p. 179, c. fig. *Thynnus*, Aldrov. iii, c. 18, p. 313, c. fig. *Pelamys Belonii*, Willugh. p. 180. *Pelamys sarda*, Ray, p. 58. *Scomber*, No. 2, Var. Artedi, Synom, p. 50. *Scomber pelamys*, Brünn. Ich. Massil. p. 69.

Scomber sarda, Bloch, t. cccxxxiv; Bl. Schn. p. 22; Mitch. Trans. Lit. and Phil. Soc. New York, i, p. 428; Lacép. iv, pp. 699-700; Risso, Ich. Nice, p. 168.

Scomber mediterraneus, Bl. Schn. p. 23; De la Roche, Ann. Mus. xiii, p. 336.

Scomber ponticus, Pall. Zoogr. Rosso-Asiat. p. 17.

Thynnus palamitus, Rafin. Caratt. 44.

Thynnus pelamis and sarda, Risso, Eur. Mérid iii, pp. 415, 417.

Pelamys sarda, Cuv. and Val. viii, p. 149, pl. ccxvii; Yarrell, Brit. Fish. (Ed. 3) ii, p. 226*a*, c. fig.; Storer, Fish. Mass. p. 4: De Kay, New York Fauna, Fish. p. 106, pl. ix, f. 27; Cuv. Règne Anim. Ill. Poiss. pl. xlviii, f. 2; Swainson, Fishes, ii, p. 238; Guichen. Explor. Algér. Poiss. p. 58; Nord. in Demid. Voy. Russ. Mérid. iii, p. 392; Lowe, Proc. Zool. Soc. 1850, p. 248; Val. in. Webb and Berth. Iles Canar. Poiss. p. 50; Gray, Ann. and Mag. Nat. Hist. (3) 1859, iv, p. 399; White, Catal. Brit. Fish. p. 31; Günther, Catal. ii, p. 367; Steind. Ich. Span. u. Port. 1868, p. 8; Malm. Œfv. Akad. 1870, p. 837; Moreau, ii, p. 430.

The plain bonito, Yarrell, Brit. Fishes, (Ed. 3) p. 224 (figure not description).

Pelamid, Couch, Fish. Brit. Isles, ii, p. 102, pl. lxxxv.

Short finned tunny, Couch, l. c. p. 425, pl. lxxxii*.

B. vii, D. 22 | $\frac{2}{13\text{-}14}$+VIII-IX, P. 25, V. 1/5. A. $\frac{2}{13}$+VII, C. 26, Vert. 50.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of lobes of caudal fin 6, height of body 5 in the total length. *Eye*—with a narrow adipose lid on either side, diameter 6 in the length of the head, 2 diameters from the end of the snout and also apart. Snout compressed and conical: jaws of equal length in front: the maxilla reaches posteriorly to beneath the hind edge of the orbit. *Teeth*—in a single row in the jaws, of moderate strength anteriorly, increasing in size posteriorly: a pair of canines in the lower jaw above the symphysis and posterior to the outer row: a row on the palatines, none on the vomer. *Fins*—dorsal spines of moderate strength, increasing in height to the second and third, from thence they gradually decrease in length, the posterior eight or nine being very short, the last being close to the commencement of the second dorsal: the latter fin is highest in front, where however its height is less than the length of its base. Pectoral short in the example described (which is 18 inches long), being 1/10 of the total length and less than half the length of the head. Ventrals shorter than the pectorals. Anal commences on a vertical line beneath the middle of the second dorsal fin to which it is similar. Caudal with pointed lobes. *Scales*—anteriorly form a corselet on the body, which has a central prolongation beneath the pectoral fin, an inferior prolongation at the ventral fin, and a superior one which passes along the base of the first dorsal. The remainder of the body is likewise covered with fine scales. *Air-bladder*—absent. *Colours*—back of a bluish colour shot with purple, and traversed by narrow oblique bands which pass backwards and upwards to it from the abdomen:

a series of broad bars descend down the upper half of the sides of the fish, which are most distinct in the young and frequently lost with age. The first dorsal fin nearly black, in large examples the posterior spines are white: second dorsal yellowish, with a dark upper half and white summit: caudal and pectoral black: lower fins yellow with dark markings.

Names.—*Pelamid* and *belted bonito.*

Habits.—Said to be very wary, and arrives off the coasts of Sicily in great abundance during the spring, and likewise in the autumn, when many are captured. This fish is a rapid swimmer, and has been seen springing into the air after its prey. In September, 1836, in very fine weather, with the sea smooth, a large number of fishes, which Couch considered to be of this species, were perceived in pursuit of sauries, and the same has happened on other occasions.

Means of capture.—In Sicily, according to Rafinesque, they are frequently taken in the spring by the tunny fishers. Off the British coasts they are occasionally secured along with the mackerel and their allies.

As food.—In Sicily, Rafinesque stated, they were held in even more estimation than the tunnies; while they are salted and prepared in a similar manner to the latter, and are of considerable mercantile importance.

Habitat.—This fish is abundantly spread throughout the Mediterranean to the Black Sea, and also through the Atlantic Ocean, extending along the shores of North America from Cape Cod to Florida, and in the Eastern Hemisphere from Scandinavia (Malm), Holland (Hubrecht), and the British coasts so far as the Cape of Good Hope.

In June, 1859, an example 22½ inches in length, and 4 lb. 6 oz. in weight, was captured at North Esk in a salmon bag-net, and is now in the Montrose Museum (Gray, Ann. and Mag. (3) iv, p. 399): in 1860, on December 4th, one, 14 inches long, was secured at Swanage in Dorsetshire, and is figured in Couch; in August, 1877, one, 17 inches long, and weighing 2 lb. was taken in a ground seine at Mevagissey (Gatcombe, Zool. p. 452).

It is evident that many more examples of this fish have been captured but recorded under a wrong name. Couch in his appendix, under the designation of *short-finned-tunny*, figures this species from an example taken in a drift net on August 18th, 1865, by Mr. Dunn, of Mevagissey, and states that within a week another example was secured in the same manner by a fisherman at Polperro, and in the first week in September three more. The first was only 6 inches from the snout to the fork of the tail, and the three last only reached to the length of 8 inches. This leads to the conclusion that the fishes placed by Mr. Dunn under the name of *short finned tunnies* were really pelamids, he having been led into this error by Mr. Couch who fortunately figured one of Mr. Dunn's examples. He observes that in the year 1865 young specimens were plentiful, several were caught at Mevagissey, Polperro, Gorran, and Portloe.

Dunn observes of the pelamid, that "it is rare now. I never saw but two; their casts are in the South Kensington Museum. They probably might have been more plentiful in the past. Some of our old men speak of catching mackerel of 7 lb. weight on plummet lines; no doubt they were pelamids. Nearly all the fishermen who saw my specimens called them mackerel." The casts, which I have examined, are those of *Pelamys sarda.*

It is remarkable how this fish has become mistaken for the "short finned tunny," even so early in the history of Ichthyology as seen in Willughby, 1686, p. 180, who was followed by various authors.

Mr. Cornish is unable at this distance of time to give further information as to whether the following fishes were "short finned tunnies" or "pelamids;" he observed, however, in 1868 that the dorsal fin rays did not agree with Couch's description and figure, but did not note the points of difference. He recorded (Zoologist, 1868, p. 1263) one captured at Penzance, August 20th, $8\frac{9}{10}$ inches in length: in 1877 (l. c. p. 452), another 19½ inches long, and in August, 1880, a third, 23 inches in length and weighing 6 lb. (l. c. p. 366). This last was so like a mackerel that a casual observer might well have taken it for a giant mackerel. It never reaches the size attained by the larger tunnies, 3 feet in length being the maximum recorded size.

Genus V.—Auxis, *Cuv. and Val.*

Branchiostegals seven: pseudobranchiæ present. Body oblong and somewhat elongated. Cleft of mouth deep. Small teeth in the jaws, but vomer and palatine bones toothless. Two dorsal fins with a long space between them, the spines of the first weak. Seven to nine finlets behind the second dorsal and anal. Scales forming a corselet in the anterior portion of the body. Lateral-line unarmed: a longitudinal keel along the free portion of the tail. Air-bladder absent. Pyloric appendages dendritical.

Geographical distribution.—From the German and Atlantic to the Indian Ocean; likewise in the Mediterranean.

Auxis rochei, Plate XXXIX, fig. 1.

Scomber tazo (Commers.), Lacépède, iii, p. 9.
Scomber rochei, Risso, Ich. Nice, 1810, p. 165.
Scomber bisus, Rafin. 1810, p. 45, t. ii, f. 1.
Thynnus rocheanus, Risso, Eur. Mérid. iii, p. 417.
Auxis vulgaris, Cuv. and Val. viii, p. 139, pl. ccxvi; Yarrell, Brit. Fishes, (Ed. 2), i, p. 160, c. fig. (Ed. 3), ii, p. 224 (not figure); Cuv. Règne Anim. Illus. Poiss. pl. xlviii, f. 1; Swainson, Fishes, ii, p. 238; Lowe, Proc. Zool. Soc. 1850, p. 248.
Auxis taso, Cuv. and Val. viii, p. 146.
Thynnus brachypterus, Yarrell (Ed. 3) ii, p. 219 (figure, not description).
Auxis bisus, C. Bonap. Catal. No. 679; White, Catal. Brit. Fish. p. 32; Moreau, ii, p. 415.
Auxis thynnoides, Bleeker, Ternate, v, p. 301.
Auxis rochei, Günther, Catal. ii, p. 369; Canestr. Fauna Ital. p. 103; Nilss. Œfv. Sven. Vet. Akad. Förh. 1864, p. 500, t. vi; Steind. Ich. Span. u. Port. 1868, p. 10; Winther, Prod. Ich. Dan. Mar. p. 14.
Plain bonito, Couch, Fish. Brit. Isles, ii, p. 105, pl. lxxxvi.

B. vii, D. 10-11/11-12+VIII-IX, P. 21-22, V. 1/5, A. 11-12+VII, C. 24, Vert. 39.

Length of head $4\frac{1}{3}$ to $4\frac{1}{6}$, of lobe of caudal fin 9, height of body $4\frac{1}{2}$ (to 6 in the young) in the total length between the end of the snout and the centre of the base of the caudal fin. *Eye*—with narrow adipose lids, the anterior of which overlaps the posterior one inferiorly: diameter of eye 1/4 to 2/9 of the length of the head, 3/4 to 1 diameter from the end of the snout, and the same distance apart. Jaws of about the same length anteriorly, or the lower slightly the longer: the posterior extremity of the maxilla reaches to beneath the middle of the eye. *Teeth*—rather small in the jaws, absent from the tongue and palatine bones. *Fins*—first dorsal of a triangular form, it commences above the origin of the pectoral, the highest ray equalling the length of the latter fin: a considerable interspace exists between the two fins: second dorsal low, finlets small. Ventrals situated beneath the base of the pectoral. Anal commences on a vertical line beneath the first dorsal finlet. Caudal deeply lobed. *Air-bladder*—absent. Stomach elongated into a long and pointed cœcal portion, as shown in the figure (plate xxxix). *Scales*—form a corselet over the chest, and prolonged posteriorly in the vicinity of the dorsal, pectoral, and ventral fins, this is not distinct in the very young. Median and lateral keels near the base of the caudal fin well developed. *Colours*—bluish superiorly, becoming silvery white on the sides and beneath, in some examples the back being indistinctly marbled: the corselet is slightly darker than the body posterior to it. Fins gray, the anal having a yellowish tinge.

Varieties—in colour have been recorded. The back may have dark spots with light edges.

Names.—*Plain bonito* was so named by Yarrell in contradistinction to the other forms which are belted or banded. *L'Auxide commune* and *Bounitou*, French.

Means of capture.—In the Mediterranean a regular fishery exists for them from May until September: they are also captured along with the tunnies.

Breeding.—Appears to deposit its spawn about August: the ova are white and invested with a reddish, albuminous covering. The females are said to be larger than the males.

As food.—When fresh its flesh is but little esteemed, being red and hard like a coarse mackerel, consequently it is usually salted or pickled. This process, however, must be soon effected because decomposition is very rapid, and should the fish be kept three or four days it becomes of a blackish colour.

Habitat.—Scandinavian seas, the Atlantic Ocean, extending to Jamaica: also the Indian Ocean. In the Mediterranean it is rather rare, but is taken along with the tunny. Risso remarks that it appears off Nice in the spring, summer, and autumn. In some localities in Sicily it is frequently observed.

Lowe observed a single example at Madeira February 3rd, 1845, and remarked that it was not quite unknown to the fishermen, but its occurrence was said to be a mere chance. June, 1839, two examples were captured at Yarmouth, and came into Mr. Yarrell's possession. 1843, one was taken at Looe, in Cornwall, and two were captured in Mount's Bay, one taken in 1844 being the example figured by Couch: it was preserved in the Museum of the Natural History Society at Penzance. September, 1847, another was captured off Yarmouth, and was secured for the Cambridge Philosophical Society. Mr. Gordon reported to Mr. Couch the occurrence of this fish in the Moray Firth. Mr. Dunn observes in his remarks on Cornish Fishes "one of these was landed here last week." Edward records several from Banffshire, and remarks respecting one that a "very peculiar feature connected with it was, that if stroked down when wet it gave the hand all the appearance of having come across a piece of metal newly black-leaded."

Yarrell's example measured 18 inches in length. Risso observes that the weight does not exceed 6 lb.

Genus VI.—Echeneis, *Artedi.*

Remoropsis, Rhombochirus, Remilegia, Leptecheneis, Phtheirichthys, Gill.

Branchiostegals seven or eight: pseudobranchiæ well developed. Body elongated and fusiform: head depressed and superiorly provided with an adhesive organ. Eyes lateral, and directed obliquely downwards and outwards. Cleft of mouth deep. Villiform teeth, occasionally with larger ones intermixed, on the jaws, vomer, palatine bones, and generally on the tongue. The first dorsal fin modified on the summit of the head and occiput into an adhesive disk: second dorsal and anal with many or a moderate number of rays: no finlets: ventrals thoracic. Scales minute. No keel on the sides of the tail. Air-bladder absent. Pyloric appendages in moderate numbers.

The fishes of this genus at one time were considered malacopterygians, as no spinous dorsal fin was observable: they now form the group *Echeneidæ* of Müller, the sub-family *Echeneidina* of Cantor, and the family *Echeneoidei*, Bleeker. Gill has divided them into two groups composed of six genera. Lütken likewise sub-divides them into two sub-genera. They are subject to great alterations with age, in some the central rays in the caudal fin of the young form a long and filiform prolongation, which disappears with adolescence, the tail often becoming lunated. The number of laminæ in the sucker is variable, as are also the fin rays and the roughness or the reverse of the tongue. They are inhabitants of nearly all the temperate and tropical seas, and are most usually captured adhering to sharks. Van Beneden has pointed out that, as they do not prey upon the fishes to which they are indebted for house room and the means of locomotion from one place to another, they cannot be termed "parasites;" so he named them "commensals" or "messmates," which may be either adherent to other animals or else free swimmers. An example of a true parasitic fish exists in our seas in the "myxine" or "hag," which burrows into and feeds upon the flesh of other fishes. But the sucker of the *Echeneis*, by which it maintains its hold, is placed on the upper surface of the head, and is evidently a modified first dorsal fin, as was first observed by Voigt. It is flat, of an oval shape, and composed of transverse laminæ directed backwards and having a tooth-like posterior margin to each, supported by these are a modified dorsal spine which having divided into two vertical halves becomes bent outwards to the right and left side, and forms a support to the laminæ; while along its central line a smooth but narrow elevation extends, so that a vacuum may when desirable be restricted to one-half of the disk. The most anterior of these transverse laminæ are directed slightly forwards, and the posterior slightly backwards. External to this disk, and encircling its whole margin, is a wide fleshy membrane. This apparatus acts as a sucker similarly to the leather plaything employed when moist by schoolboys for the purpose of being attached to a stone or other flat substance. As the anatomical characters of this disk have been fully explained by several authors, further remarks upon it appear to be unnecessary.

When the accounts of the wonderful power of this sucking fish were first credited it is impossible to say, but they certainly are found in Ovid and Pliny. The names *Echeneis* and *Remora* have been given this fish in consequence of its possessing a sucker, and the uses to which it has been supposed to be put—the first, by the Greeks, being a word composed of two others, signifying a fish which retards or arrests the progress of a ship. The Latin term similarly implies delay, and, though doubtless it was given for the identical reason for which the Greeks employed their designation, it seems to have likewise had another meaning. Meeting one of these fish while bathing during the progress of a love or law suit, or any business that required despatch, was considered a bad omen. Buckland observed that this fish figures as a symbol of *prudence* in an Oxford chapel window. "Prudence" carrying "upon her right arm an arrow joined with a *remora*, a fish that fixes itself to the bottom of ships and retards their progress."

The *arrow* represents quickness, the *remora* slowness, while prudence is supposed to be the medium or unknown quantity. Pliny, whose imagination was very vivid, has left some curious records of what the sucking fish was believed to accomplish in his days. The version is that of one of our old translators, Philemon Holland. "One little fish, not above half a foot long, is able to arrest and stay per force, yea, and hold as prisoners, our goodly tall and proud ships, so well armed in the beake-head with yron pikes and brasen tines; so offensive and dangerous to bouge and pierce any enemie ship which they do encountre. Certes, reported it is, that in the naval battaile before Actium, wherein Antonius and Cleopatra the queene were defeited by Augustus, one of these fishes staied the admirall ship wherein M. Antonius was, at what time as he made all the hast and meanes he could devise with help of ores to encourage his people from ship to ship, and could not prevaile, untill he was forced to abandon the said admirall and go into another galley. . . . Of late daies also, and within our remembrance, the like happened to the roiall ship of the emperor Caius Caligula, at what time as he rowed back and maide saile from Astura to Antium, when and where this little fish detained his ship, and (as it fell out afterwards) presaged an unfortunate event thereby. . . . And yet it was not long ere the cause of this wonderful staie of his ship was knowne: for as soon as ever the vessel (and a galliace it was, furnished with five bankes of ores to a side) was perceived alone in the fleete to stand still, presentlie a number of tall fellows leapt out of their ships into the sea to search what the reason might be that it stirred not; and found one of these fishes sticking fast to the very helm." He tells us how Caius Caligula fumed, and was unable to comprehend how a little sucking-fish could withstand the power of four hundred oars. Recent authors, who attach but small credit to the accuracy of such traditions, have attributed the procrastination of Mark Antony to the loadstone of Cleopatra's eyes, which perhaps, more than the sucking-fish, occasioned delay; while they have also asserted that inebriation in Caligula's rowers sufficiently accounts for his fuming, and explains why the vessel was unable to make way.

Not only were these ancient authors adepts at marvellous descriptions respecting the attributes of these fishes, but even Commerson, and some later writers have drawn largely upon the credulity of their readers, asserting that along the coasts of Mosambique they are employed for the purpose of capturing turtle. A ring is stated to be fixed round the fish's tail, and to this a cord is made fast; thus ready for use, the *Echeneis* is placed in a vessel of sea-water, which having been embarked in a boat, the rowers proceed on a turtle hunt. As soon as one is seen sleeping on the ocean, they row gently towards it; when sufficiently near, they cast the sucking-fish into the sea, which was said to attach itself to the object of their search and with such tenacity that both can be drawn into the boat! Commerson likewise asserted that the sucker of one of these fishes being applied to his thumb, it became perfectly numbed, and continued thus for some considerable time.

The sucking-fish, although capable of spasmodic active exertions, appears to generally lead an inactive life, trusting to its host to convey it to the localities suitable for obtaining food. It does not seem to find the vicinity of the shore or the presence of brackish waters agreeable, preferring the open seas, although not infrequently observed in harbours. Some hundreds sometimes affix themselves to one vessel, and when the washings of the cook's coppers are thrown overboard, they shoot off in a body to pick up the particles of grease which discolour the water. They also consume less savoury matters that drop from a ship, and may be caught with a very small hook buried in a pellet of fat. (Richardson, Ich. China and Japan, p. 204.) Van Beneden has observed that they eat small fish, while they themselves occasionally form food for sailors, who are not always particular as to the quality of the articles upon which they make a repast. Lütken (Vidd. Medd. 1877, p. 242) has observed that *Echeneis lineata* attaches itself especially to *Sphyræna barracuda* as *E. remora* does to *Carcharias lamia*.

Echeneis remora, Plate XXXIX, fig 2.

Εχενηὶς, Plutarch, Sympos. lib. ii; Oppian, Halieut. i, p. 9. Φθειρ, Aristot. Hist.

Echeneis, Ovid, Hal. v, 99; Pliny, xxii, c. 1, ix, c. 25; Ælian, i, c. 36, iii, c. 17; Wotton, De Differ. p. 149. *Remora*, Rondel. xv, c. 18, p. 436; Petiver, Gazophyl. t. xliv, f. 12; Jonston, de Pisc. lib. i, tit. 1, c. ii, art. iv, p. 16, t. iv, f. 3; Ray, p. 71. *Zuiger*, Nieuhoff, Brass. Zee-en Lant-Reize, ii, p. 274, f. 67. *Remora imperati*, Willughby, Appendix, p. 5, t. ix, f. 2. *Sucking-fish*, Edward's Gleanings, No. 210. *Mediterranean Remora*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 524. *Echeneis*, sp. Klein, MSS. iv, p. 51, No. 1; Gronov. Zooph. p. 75, No. 256, and Mus. Ich. i, No. 33; Duhamel, Pêches, ii, Sect. 4, p. 56, pl. iv, f. 5.

Echeneis remora, Linn. Syst. i, p. 446, and Amœn. Acad. i, p. 320, and Mus. Reg. Ad. Frid. i, p. 75; Osbeck, Voy. China, p. 94; Schœpff, Schrift. Gesel. Nat. Freunde Berlin, viii, 3, p. 145; Bloch, t. clxxii; Gmel. Linn. p. 1187; Lacép. iii, pp. 146, 147, t. ix, f. 1; Bl. Schn. p. 240; Blumenb. Abbild, t. lxxviii; Bonnaterre, p. 57, pl. xxxlii, f. 123; Shaw, Zool. iv, p. 201, pl. xxxi; Risso, Ich. Nice, p. 177, and Eur. Mérid. iii, p. 269; Müll. Prod. Faun. Dan. No. 361; Mitch. Trans. Lit. and Phil. Soc. New York, i, p. 378; Turton, Brit. Fauna, p. 94; Richards. Faun. Bor. Amer. p. 265; Faber, Fische Islands, p. 115; Temm. and Schlegel, Fauna Japon. Poiss. p. 271; De Kay, New York Fauna, Fishes, p. 309; Bonap. Pesc. Eur. p. 66; Lowe, Trans. Zool. Soc. iii, p. 16; Bennett, Whaling Voyage, p. 271; Jenyns, Voy. Beagle, Fish. p. 142, and Man. Vert. p. 473; Thompson, Mag. Nat. Hist. (2) 1846, p. 314, and Nat. Hist. Ireland, iv, p. 222 Yarrell, Brit. Fish. (Ed. 2) ii, p. 377, c. fig. (Ed. 3) i, p. 671; White, Catal. Brit. Fishes, p. 56; Günther, Ann. and Mag. Nat. Hist. 1860, p. 390, Catal. ii, p. 378, and Fische Gode. Mus. Heft. v, p. 156; Gill, Proc. Acad. Nat. Sc. Phil. 1864, p. 60; Couch, Journ. Roy. Soc. Corn. 1867, p. 361; Kner, Novara Fische, p. 146; Bleeker, Madagascar, p. 99; Day, Fishes of India, p. 258; Moreau, Poiss. France, ii, p. 535, c. fig.

Echeneis squalipeta, Dald. Nat. Selskab. ii, p. 157; Bl. Schn. p. 240; Günther, Catal. ii, p. 377 (*young*).

Echeneis naucrates, Risso, Eur. Mérid. iii, p. 270.

Echeneis jacobea and *pallida*, Lowe, Pro. Zoo. Soc. 1839, p. 89, and Trans. Zool. Soc. iii, pp. 16, 17.

Echeneis remoroides, Bleeker, Batoe, ii, p. 70.

Echeneis parva, Gronov. ed Gray, p. 92.

? Echeneis borboniensis, Guich. in Maillard Reunion, Appen. p. 19.

Remora, Couch, Fish. Brit. Isles, ii, p. 113, pl. lxxxviii.

Remora tropica, Murray, Edinb. New. Phil. Journ. 1856, iv. p. 287.

B. vii, D. 17-18/22-24. P. 20-24. V. 1/5. A. 22-25. C. 19. Cœc. pyl. 6-8. Vert. 12/15.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, including disk 3, of disk alone $3\frac{1}{4}$, of caudal fin 6, height of body 7 to 9, of ventrals $7\frac{1}{2}$ to $8\frac{1}{4}$, breadth between pectoral fins 6 to $6\frac{1}{2}$ in the total length. *Eye*—placed in the middle of the length of the head, $3\frac{1}{4}$ to $3\frac{1}{2}$ diameters from the end of the snout, and 5 apart. Its direction is downwards, having its upper edge most projecting. Mouth rounded; lower jaw the longer; the posterior extremity of the maxilla does not quite reach to beneath the front edge of the eye. *Teeth*—present in a band in either jaw, that on the lower being the wider; also present on the vomer, palatine bones, and tongue. *Fins*—the disk or modified first dorsal fin is placed on the upper surface of the head and occiput, is nearly half as wide as long, containing from 17 to 18 transverse laminæ, each of which has a rough tooth-like posterior edge, while along its centre runs a narrow smooth elevation enabling the vacuum to be confined to one-half of the disk. The most anterior laminæ are directed slightly forward, the posterior more backward, while the intervening ones have an intermediate direction. External to this disk is a wide fleshy membrane which reaches posteriorly to beyond the

occiput, while anteriorly it just extends to the upper jaw. Second dorsal opposite and similar to the anal. Pectoral broad, its upper rays the longer. Caudal emarginate. *Colours*—grayish brown, sometimes becoming lighter on the sides and beneath.

Varieties.—Lowe's *Echeneis jacobæa*, includes such forms as possess a truncated caudal fin, and *E. pallida* those in which the tongue is rough, a somewhat uncommon modification but having no specific value any more than has the form of the tail fin. Günther (Zool. Record, 1864, p. 155) suggests that *E. remeligo*, A. Dumeril, is probably an example of this species. *Colour*—Commerson observed that when many of these fishes are seen attached to one object it is not uncommon to see one or two which differ from the rest in being of a whitish colour.

Names.—Aristotle's name for this fish signifies "a louse," and which he observed was found on the dolphin. Withal, 1608, terms this fish *suckstone*, a designation more appropriate to the "lamprey," which was perhaps intended, as the *Echeneis* has very rarely been captured in Britain.

Habits.—Commerson asserted that it swims with its back downwards, but Sir J. Richardson remarked that its motions are wriggling like those of an eel, swimming with considerable velocity, and able to overtake with ease a vessel going before a brisk gale. Bennett says it merely swims round the body it attends, and only fixes on it occasionally and for a very short time. Cornish observes that it injures the skin of the shark to which it is attached (Zoologist, 1880, p. 2225); Schœpf accounting for its presence in various parts of the world, mentions having seen it taken from several vessels recently arrived at New York. De Kay alludes to an example captured a considerable distance up the Hudson River, while Catesby remarks upon observing sucking-fishes disengaged and swimming very deliberately near a shark's mouth without its attempting to swallow them, the reason for which he felt himself unable to give.

Means of capture.—Sailors are said to sometimes take these fish by means of a bait of fat enclosing a small hook.

Uses.—The Malays consider this fish powerful manure for fruit trees.

Habitat.—Both sides of the Atlantic, the Mediterranean where it is rare, the Pacific Ocean, East and West Indies. In Europe it has been captured so far north as Iceland (Olafsen) and Denmark, but is rare in British waters, which is somewhat remarkable as the blue shark to which it elsewhere attaches itself is not uncommon along our shores. Perhaps the temperature of the water is too low for its requirements. In the British seas it is evidently a mere wanderer, which has been brought attached to a whale, large fish, or some floating object which afford him house room and water carriage to climes scarcely best adapted to his requirements, but from whence a return conveyance may be difficult to obtain.

The number of instances in which captures of this fish have been recorded from the seas of Great Britain and Ireland are but few.* Turton, in his "British Fauna," observes, "taken by the author in Swansea from the back of a cod-fish in the summer of 1806." Mr. Dillwyn, in his "Fauna of Swansea," entertained doubts respecting the accuracy of Turton's assertion, having "strong grounds for believing that there was some mistake about it." In July, 1848, one was captured at Clontarf, Dublin Bay, adhering to the gills of a blue shark, *Carcharias glaucus*, ten feet long, which had been observed in shallow water and driven ashore the previous night. A second remora was attached to the gills on the opposite side, but when disturbed it disappeared inwards by the bronchial orifices, and was not seen again. Mr. Dunn obtained a specimen (which he gave Mr. Couch) in 1867 from a blue shark taken eighteen miles off Deadman's, near Mevagissey. In the British Museum Catalogue one is thus alluded to: "Half-grown. Guernsey. Presented by Mrs. Mauger." Likewise two others, also half-grown, from an unknown locality, received from the same donor. Without further information, Couch's incredulity as to the first having come from Guernsey may be a not unmerited criticism.

* For an instance of taking one of these fishes in a bottle at the Nore, see *Introduction*.

Family, X—STROMATEIDÆ, *Swainson.*

Branchiostegals from five to seven: pseudobranchiæ present. Body oblong or slightly elongated and compressed. Gill-openings wide. Eyes lateral. No osseous articulation between the infraorbital bones and the preopercle. Small teeth in the jaws, palate edentulous: barbed teeth extend into the œsophagus. A single elongated dorsal fin without any distinct spinous division in the adult: ventrals, when present, thoracic. No prominent papilla near the vent. Air-bladder small when present. Pyloric appendages few, in moderate numbers, or many. Vertebræ exceed 10/14.

Geographical distribution.—Pelagic and littoral forms, which are found in most of the tropical and temperate seas.

Genus I.—Centrolophus, *Lacépède.*

Pompilus, Lowe.

Branchiostegals seven: pseudobranchiæ present. Cleft of mouth of moderate depth or rather small. A band of small teeth in the jaws, absent from vomer, palatines, and tongue. A single elongated dorsal fin, without any distinct spinous division: it and the anal have a scaly base. Air-bladder small. Pyloric appendages nine or ten.

Geographical distribution.—Mediterranean, coasts of the British Isles and France to Madeira; also found in Peru, as *C. Peruanus*, Steind., in the South Pacific Ocean.

1. **Centrolophus Britanicus,** Plate XL, fig 1.

Centrolophus britanicus, Günther, Annals and Mag. Nat. Hist. 1860, July, p. 46, and Catal. Fish. Brit. Mus. ii, p. 402

Cornish centrolophus, Couch, Fish. Brit. Isles, ii, p. 127, plate xci.

B. vii, D. 46, P. ?, V. 1/5, A. 30, C. 17.

Length of head about 6, of caudal fin $6\frac{1}{3}$, height of body $3\frac{4}{5}$ in the total length. *Eye*—4 diameters in the length of the head, 1 diameter from the end of the snout, and 2 apart. Judging from the unique example, which is a badly stuffed specimen, the profile from the dorsal fin to the snout is only slightly more convex than that of the inferior surface of the head. The posterior extremity of the maxilla reaches to beneath the anterior margin of the eye. *Fins*—dorsal commences on a vertical line above the base of the pectoral and reaches to about the distance of half the length of the head from the base of the caudal, the length of its base being equal to about 6/11 of the entire length of the fish: anal commences below the middle of the dorsal fin and extends to the same distance from the tail, the extent of its base equalling 2/7 of the entire length of the fish. Pectoral and ventrals very short, having been "much mutilated from injury when cast on shore." Caudal forked. *Scales*—small; they form a sheath to the basal two-thirds of the dorsal and anal fins. *Lateral-line*—at first forms rather a considerable curve. *Colours*—of an uniform brownish-pink; lighter on the lower surface; the fins, especially the caudal, being of a still deeper tinge than the back.

The history of this supposed unique example of *Centrolophus* is remarkable, for the proportions have been entirely altered by the person who mounted the specimen, and Couch's illustration and the description in the British Museum Catalogue have followed the stuffed fish. Couch fortunately measured it prior to sending it to be stuffed, and recorded that its length was "one foot seven

inches," . . . "the vent at about the middle of the body." This measurement, as will be seen by his figure, does not include the caudal fin, while at the vent it was "five inches in depth." He mentions having made a drawing of the fish before it was preserved, which probably had solely allusion to its colours, as the figure in the "Fishes of the British Isles" is evidently taken from the stuffed one. If reference is made to the specimen in its present state at the British Museum its length will be found to have increased from 19 inches, as it was when captured, to 22 inches as it is now when mounted, or 3 inches too long, which length can only have been obtained at the expense of its height. Above the vent at the centre of its length, instead of its height being 5/19 of the total, it is about 5/22, and this disproportion is still further augmented in Couch's figure where it is about 5/26. If, as stated in the British Museum Catalogue, the height of the body is 5 in the total (when according to Couch the body was 5 inches high), the length of the entire fish should have been 25 inches, whereas it was merely 19.

Habitat.—This unique example was thrown on the shore not far from Looe, in Cornwall, in the middle of February, 1859, when it came into Mr. Couch's possession, and was presented by him to the British Museum where I drew my figure from the specimen—giving the length of the head and fin rays as existing, but reducing the stretched skin to what obtained when recently captured. The mouth seems a little distorted, and the fin rays in many instances are broken. The specimen, in short, has been injured by its captor, broken by its preserver, and is somewhat deteriorated by age.

2. **Centrolophus pompilus,** Plate XL, fig 2.

Pompilus, Rondel. viii, c, 14, p. 250, c. fig.; Gesner, Aquat. iv, p, 753; Aldr. iii, c. 19, p. 325; Jonston, De Pisc. lib. i, tit. i, c. 2, art. ii, p. 14, t. iii, f. 5; Ray, p. 101. *Pompilus rondeletii*, Will. p. 215, t. O. 1, f. 6. *The black fish*, Jago in Borlase, Cornwall, p. 271, t. xxvi, f. 8. *Black ruffe*, Pennant, Brit. Zool. (Ed. 1) iii, p. 260 (Ed. 2) iii, p. 228. *Merle*, Duhamel, Pêches, ii, Sect. iv, p. 37, pl. vi, f. 2.

Coryphæna pompilus, Artedi, Gen. 16, syn. 29; Gmel. Linn. p. 1193; Bonnaterre, p. 60, pl. xxxiv, f. 130; Risso, Ich. Nice, p. 180.

Perca nigra, Gmel. Linn. p. 1321.

Holocentrus niger, Lacép. iv, pp. 330, 357; Shaw, Zool. iv, p. 558.

Centrolophus niger, Lacép. iv, pp. 441, 442, pl. x, f. 2.

Centrolophus pompilus, Cuv. and Val. ix, p. 334, pl. cclxix; Yarrell, Brit. Fish. (Ed. 1) i, p. 158, c. fig. (Ed. 2) i, p. 247 (Ed. 3) ii, p. 247; Cuv. Règne Anim. Ill. Poiss. pl. lxv; Bonap. Faun. Ital. Pesc. c. fig.; Guichen. Explor. Algér. Poiss. p. 63; White, Catal. Brit. Fish. p. 39; Günther, Catal. ii, p. 403; Canestr. Fauna Ital. p. 105; Andrews, Proc. R. Dub. Soc. vi, p. 68; Giglioli, Cat. Pesc. Ital. p. 26; Moreau, Poiss. France, ii, p. 492, c. fig.

Acentrolophus maculosus, Nardo, Prod. Ich. Adr. sp. 62.

Centrolophus liparis, Risso, Eur. Mérid. iii, p. 336; Cuv. and Val. ix, p. 345.

Centrolophus morio, Cuv. and Val. iv, p. 342.

Coryphæna morio, Jenyns, Man. Brit. Vert. p. 370.

Pompilus rondeletii, Lowe, Pro. Zool. Soc. 1839, p. 81.

Black fish, Couch, Fish. Brit. Isles, ii, p. 123, pl. xc.

B. vi. D. 38-41, P. 21, V. 1/5, A. 23-25, C. 17. Cœc. pyl. 6-9, Vert. 11/14.

Length of head 5, of caudal fin 5 to $5\frac{1}{4}$, height of body 4 to 5 in the total length. *Eye*—which has a sort of skinny lid, is rather high up, diameter $3\frac{1}{4}$ to 4 in the length of the head, and 3/4 to 1 diameter apart. Snout rather obtuse and slightly projecting over the upper jaw. Jaws of nearly equal length anteriorly, and reaching posteriorly to beneath the first third of the orbit. The profile from the dorsal fin to the snout is slightly concave over the occiput. *Teeth*—minute ones in the jaws. *Fins*—the dorsal commences on a vertical line above the first third of the pectoral fin, the length of its base equalling from

$2\frac{2}{3}$ to 3 in that of the entire length of the fish, the first few rays are unbranched and weak, the highest portion of the fin is in its first third. Pectoral two-thirds as long as the head: ventral slightly shorter. Anal commences beneath the middle, and the length of its base is about equal in extent to half that of the dorsal fin. Caudal deeply forked. *Scales*—small, they form a sheath to the basal half or third of the vertical fins. *Lateral-line*—forms a gradual curve to opposite the end of the pectoral fin, when it proceeds direct to the base of the caudal. The length of the caudal peduncle equals about two-thirds of that of the head, while the height of its base is from $1\frac{2}{3}$ to 2 in that of its length. *Colours*—these vary, generally being of an uniform brown, lightest beneath: some irregular cloudy longitudinal and sinuous markings on the body, and some oblong light spots along the sides, and dark ones on the fins: these markings in some are yellow, while others have none. Risso says that the young (which are taken during the spring) have dark transverse bands.

The history of this marine species is interesting, as showing how known forms have become overlooked and new names substituted for old ones. No reasonable doubt can exist against its being the *Pompilus* of the Mediterranean, described by Rondelet, who in 1554 published a recognizable figure. It was subsequently adverted to by Gesner 1558, Aldrovandus 1638, Jonston 1649, Willughby 1686, Ray 1713, and others: several of these authors likewise giving representations. The first British examples recorded are by Borlase, in his "Natural History of Cornwall," in which (copying from the MSS. of the deceased Mr. Jago) he observes, "two were taken at Loo, May 26th, 1721, in the *Sean*, near the shore on sandy ground, with small ore-weed in the pot." The examples reached 16 inches in length, and Borlase by an error gives its width at "3/4 of an inch," instead of from "3—4 inches," whether the mistake was his or the printers is not very material as the figure is distinctly that of the *Pompilus*, and the proportions good. Pennant, in 1776, not recognizing Jago's description and figure, introduced the species into his "British Zoology" under the name of the "Black Ruffe" or "Black-fish of Mr. Jago," subsequently in his second edition, published in 1812, he termed it the "Black Perch," evidently in deference to Shaw, who in his turn had followed Lacépède. This last author in his "Histoire naturelle des Poissons" (1798-1803) had identified the "Black-fish," written "Blaufish," in the British Zoology, with *Perca nigra* of Linnæus, as had been previously pointed out by Gmelin in his edition of that author, dated 1788 (although he added his doubt whether it were not a variety of the fresh-water Ruffe). Risso in 1810 describes it in his "Ichthyology of Nice:" while Fleming in his "History of British Animals," published in 1828, and, following Gmelin's doubts, places Jago's sea-fish as an appendix to the fresh-water Ruffe, *Perca cernua*, designating the representation given by Borlase as a "manufactured figure." In 1830 and 1831 Couch re-discovered the species on the Cornish coast. In 1833 Cuvier and Valenciennes, in their magnificent work on fish, describe the "Black-fish" in detail, adding an excellent figure, as well as criticising the synonymy; since that time but little further information has been acquired respecting the species.

Habits.—Obscure, but it is said to attend vessels like the "Pilot fish," hence Rondelet named it after the term employed by the ancients, *Pompilus*, a fish held sacred on account of its friendship to man. Mr. Dunn, of Mevagissey, observed respecting an example captured in 1872 that it was the fourth of its kind known to have been taken at that place, and all in mackerel nets. In each instance they seemed to be acting the part of "pilot fishes" to some varieties of shark which had been entangled in the nets close by.

Baits.—But little is known respecting their food, the first two specimens taken in Cornwall were captured in pots baited with ore-weed, but they will eat flesh, as Couch remarks upon one being taken with a slice of mackerel used for a bait, while in its stomach were found "a mussel without a shell and a piece of flesh of a sea-bream, both these substances probably having been snatched from the hooks of fishermen.

Breeding.—Risso says that the eggs are deposited in the autumn: and the young (which have dark transverse bands) are captured in the spring.

As food.—This fish does not appear to be held in any estimation in the Mediterranean, but those which have been eaten along the British coasts have been reported as of excellent flavour, their flesh being white, soft, and flaky.

Habitat.—The Mediterranean, where, although common off Nice, it is generally rare: occasional wanderers appear off the British Isles, and in the Atlantic as far south as Madeira. It occurs along the coasts of France, the south coast of England, and one straggler was taken off Northumberland, another off Yorkshire. An example has likewise been recorded off the south coast of Ireland.

As previously observed, the two first taken in these isles were captured at Looe, May 26th, 1721. Since that time Couch mentions one which was taken in November, 1830, in a floating net set for salmon, and such was the force exerted by this fish that it carried the net before it over the head rope, when it fell into the folds and became entangled. A second is referred to by the same author as caught near Polperro in 1831, on a handline baited with a slice of mackerel. Another came with a ship into the harbour of St. Ives, and while there suffered itself to be caught with a gaff from a boat alongside. In 1841, one 14 inches in length was taken at Lossiemouth. August 27, 1850, one was taken at Falmouth in a drift net, in which it was entangled by the teeth. Mr. Alder, in his address to the "Tyneside Naturalists' Field Club," 1850, records one captured at Cullercoats in Northumberland, and which was placed in the museum. Rudd (Zoologist, 1852, p. 3504) observes that one was taken at Redcar, in Yorkshire. In February, 1857, one was obtained near Penzance, while R. Couch records another, 9 inches long, which came into his possession in the autumn of the same year. June 11th, 1870, two were captured in a trammel or flue-net set in Mount's Bay. In 1871, Mr. Andrews mentions one taken off the Irish coast. In July, 1872, Mr. Gatcome remarks (Zoologist, 1872, p. 3236) one $12\frac{1}{2}$ inches long and $3\frac{1}{2}$ deep, was taken in a mackerel net off Deadman, it appeared to have followed a large Porbeagle shark, which was captured in the same net at a few feet distance. June 15th, 1877, one was taken in a seine off Babbicombe, near Torquay (Gosse, Zool.). In August, 1878, one 22 inches long and 4 lb. weight, was taken in a trammel off Helford. Doubtless many other examples which have not been recorded have been captured along the south coast. Mr. Dunn observes that he has known about a dozen taken at Mevagissey, and every one could be traced to be following or near a large fish, generally a shark. Not long since a shark entered the harbour and when leaving it passed some small boats moored near the pier head. When the tide ebbed the boats grounded in a pool, and close by the keel of one a black-fish was taken. It was supposed that it had mistaken the boat for its companion.

The specimen, figured life size, is in the British Museum collection. This fish attains to at least 3 feet in length. Professor Giglioli was good enough to send me an example, 30 inches long, from the coast of Italy.

Family, XI—CORYPHÆNIDÆ (part), *Swainson.*

Branchiostegals from five to seven: pseudobranchiæ present or absent. Body oblong, or elevated and compressed. Gill-openings wide. Eyes lateral. No osseous articulation between the infraorbital bones and the preopercle. Teeth in the jaws small, present or absent on the palate, none in the œsophagus. A single elongated dorsal fin without any distinct spinous division in the adult: ventrals thoracic (jugular in *Pteraclis*). No prominent papilla near the vent. Air-bladder present or absent. Pyloric appendages few or many. Vertebræ exceed 10/14.

Geographical distribution.—Cosmopolitan and pelagic, and though chiefly confined to tropical and temperate seas, some are found in high northern latitudes.

Genus I.—Brama (*Schneider*) *Risso.*

Taraxes, Lowe (*Young*). *Pterycombus*, Fries (*Young*).

Branchiostegals seven: pseudobranchiæ well developed. Body elevated and compressed. Cleft of mouth oblique: lower jaw the longer. Opercles entire. Teeth in the jaws, the outer row being much the strongest: deciduous ones on the vomer and palatines. Dorsal fin many rayed, the first three or four being spines: anal with two spines and similar to dorsal. Ventrals small and thoracic. Caudal deeply forked. Scales extended on to the head and vertical fins. Air-bladder absent. Pyloric appendages few.

Taraxes, Lowe, was considered by Poey (An. Soc. Esp. v. p. 148) to be probably the young of this species. Lütken (*Spolia Atlantica*) has observed that smooth or spinate scales in these fishes may be symptomatic of age, not of distinct species, much less of genera.

Geographical distribution.—These pelagic forms are found from the Faröe Isles in the north, where they are represented by *Brama Rayii*, which extends southwards, being common in parts of the Mediterranean and found in the Atlantic as far south as the Cape of Good Hope. *B. longipinnis*, Lowe, which may be *B. Raschii*, Esmark, seems (if a distinct species) to extend from the Baltic to Madeira. The nearly allied *B. Japonica*, Hilgendorf, has been taken at Chili, New Zealand, and also in the more northern Japan. Whether *B. Dussumieri*, c. v, and *B. Orcini*, c. v, are not the young of this last species appears very questionable. This genus extends throughout most of the temperate and tropical seas of Western Europe and Africa: also the Pacific Ocean, but does not appear to have been recorded from the eastern coast of America, although the nearly allied form of *Pteraclis* has been obtained off Carolina.

1. Brama Raii, Plate XLI.

Brama marina, Willughby, App. p. 17, t. V. 12; Ray, Syn. Pisc. p. 115; Flem. Brit. An. p. 210. *Castagnole*, Duhamel, Pêches, iii, p. 26, pl. v, f. 1. *Toothed gilt head*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 243, pl. xliii (Ed. 2, 1812) iii, p. 331, pl. liv; Montagu, Trans. Linn. Soc. vii, p. 292.

Sparus raii, Bloch, t. cclxxiii; Donovan, Brit. Fish. ii, pl. xxxvii; Shaw, Zool. iv, p. 404.

Sparus brama, Bon. Enc. Ich. p. 104, pl. l. f. 192.

Brama raii, Bl. Schn. p. 99; Risso, Eur. Mérid. iii, p. 433; Cuv. and Val. vii, p. 281, pl. cxc; Hogg, Mag. Nat. Hist. i, 1829, p. 277, and Nat. Hist. Stock. on Tees, p. 26; Scouler, M. N. Hist. vi, 1833, p. 529; Jenyns, Manual, p. 359; Yarrell, Brit. Fish (Ed. 1) i, p. 117, c. fig. (Ed. 2) i, p. 133 (Ed. 3) ii, p. 165; Johnston, Berwickshire N. H. Field Club, 1838, i, p. 171; Parnell, Fish. Firth of Forth, p. 49, and Mem. Wern. Soc. vii, p. 209; Swainson, Fishes, ii, p. 214; Lowe, Trans. Zool. Soc. iii, p. 8; Guichen. Explor. Algér. Poiss. p. 56; White, Catal. Brit. Fish. p. 28; Thompson, Nat. Hist. Ireland, iv, p. 92; Günther, Catal. ii, p. 408; Schlegel, De Dieren Ned. p. 16, pl. i, f. 6; Couch, Zoologist, 1849, Append. p. xxviii, c. fig.; Steind. Ich. Span. u. Port. 1868, p. 25; Collett, Norges Fiske, p. 46: McIntosh, Fish. St. Andrew's, p. 173; Winther, Ich. Dan. 1879, p. 14; Lütken, Spol. Atlan. 1880, p. 190, pl. iv, fig. 1, 2; Moreau, Poiss. France, ii, p. 487, c. fig.

Lepodus saragus, Rafin. Caratteri di al. Nuov. Gen. p. 53, No. 144.

Sparus castaneola, Lacep. iv, p. 110; Shaw, Zool. iv, p. 424; Risso, Ich. Nice, p. 248.

Sparus niger, Turton, Brit. Fauna, p. 98.

Chætodon umbratus, Cabrera, Machado's Catal. Pece de Cadix, p. 23.

? Chætodon, sp. Couch, Trans. Linn. Soc. xiv, p. 78.

Ray's bream, Couch, Fish. Brit. Isles, ii, p. 129, pl. xcii.

B. vii, D. 3-4/29-34, P. 19-23, V. 1/5, A. $\frac{2}{27-28}$, C. 19, L. l. 80-95, L. tr. 14/23. Cœc. pyl. 5, Vert. 16/26.

Length of head $4\frac{1}{2}$ to 5, of caudal fin $4\frac{1}{4}$ to $4\frac{1}{3}$, height of body 3 in the total length. *Eye*—situated in nearly the middle of the height of the head: diameter $3\frac{1}{2}$ to 4 in the length of the head, 3/4 to 1 diameter from the end of the snout, the interorbital space forming a high crest. Body high and very compressed, with a strongly curved anterior profile: its greatest height being below the origin of the dorsal fin. Cleft of mouth oblique, the posterior extremity of the maxilla reaching to beneath the middle of the orbit: lower jaw rather prominent. Posterior nostril resembles a slit just in front of the middle of the orbit: anterior one round and patent. *Teeth*—an outer curved row of pointed and rather distant ones in the upper jaw, much larger than those of the inner series; in the lower jaw one or two rows of conical, pointed, and rather curved ones, of which two or three somewhat resemble canines: in a fine row on the palatine bones and vomer, but which, being deciduous, are often absent: none on the tongue. *Fins*—dorsal spines lower than the anterior rays, which are the highest in the anterior portion of the fin: the anal commences on a vertical line beneath the fourth or fifth dorsal ray, and is otherwise similar to that fin. Pectoral reaches to at least half the length of the base of the anal. Ventral short, with a large basal scale. Caudal deeply forked. *Scales*—cover body and head (excluding the vertical limb of the preopercle, supraorbital space, and snout) also the rays of the vertical fins. The length of the intestinal tract equals about half the distance from the snout to the base of the caudal fin. its rectal portion large and with thickened walls. *Cœcal appendages*—five. *Colours*—appear subject to considerable variation. The upper portion of the head and body is mostly of a dark blue, having a tinge of bronze on the snout; while the sides of the body are bluish, shot with purple, and becoming almost white beneath. Dorsal and anal fins of a light colour, having a narrow black edge: outer margin of caudal fin dark.

The young of this species as observed by Lütken, l. c. when only half grown, have the scales furnished with a spine on the anterior portion of the uncovered part of each, and which does not disappear until the fish approaches its adult development. Also in the very young, as about 6/10 of an inch long, the tail fin is only moderately forked and the dorsal fin commences nearer the head than in the adult, while both it and the anal are comparatively much higher, being equal in their highest portion to two-thirds or half the height of the body of the fish. But as the examples grow larger the caudal fin

becomes more forked and the dorsal and anal by degrees take on the adult characters.

Varieties.—Couch supposed that one of his examples might be a new species or differing from the ordinary form.

Names.—Thompson observes that this fish was called *hen-fish* in Ireland, a term applied to such as are of somewhat rare occurrence. *La castagnole*, French.

Habits.—Gregarious in small companies, and probably lives in deep waters in cold climes, and may be in that which is shallower where the air is not so cold. Johnston says, "I have seen two specimens only, cast on shore after a storm, and the Reverend Mr. Baird has seen another which had suffered a similar wreck on the shore below Cocksburnpath."

Means of capture.—The rule appears to have obtained that a large proportion of these fishes taken in this country have been met with dead after storms or in a dying state, as if they had become subject to some extraneous influence when wandering beyond their legitimate home. Couch, however, obtained one that was taken by a bait: while in the Mediterranean, according to Risso, this mode of capture is employed in May, June, and December.

Breeding.—Risso says it spawns in summer.

As food.—Valued for this purpose in the Mediterranean, its flesh being considered wholesome, especially during the winter months.

Habitat.—This fish has been obtained in the Faröes, and does not appear to be very rare on the south and west of Sweden, but seems always to have been obtained during or after stormy weather. In five instances, from 1825 to 1850, all were captured between November 1st and December 15th, but such dates certainly do not apply to recorded British examples. It is more common on the French coast and in the Mediterranean, where it appears to be locally abundant, as at Genoa, while one specimen in the British Museum came from the Cape of Good Hope.

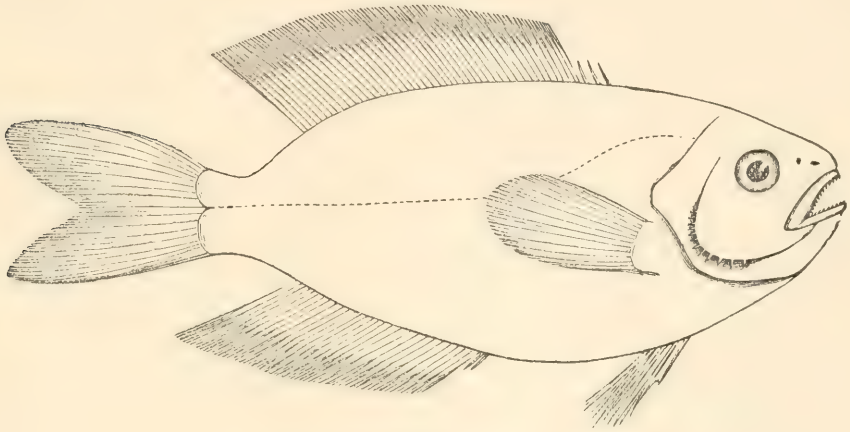
Ray gave the first account of this fish, having obtained a description and figure of one left dead on the tide receding in Middlesburgh Marsh at the mouth of the Tees in Yorkshire, September 18th, 1681: the example came into the possession of Dr. Johnson. The largest number of British examples have been taken on the north of England, Scotland, and Ireland.

In 1792, one taken at St. Andrew's was sent to the Edinburgh Museum and subsequently came into Donovan's possession. Montagu recorded it from Devonshire: Turton remarks on one taken at Swansea, November 12th, 1806. In 1821, Hogg mentioned one found at Stockton-upon-Tees. "Miss Gurney in her Diary (Trans. Norwich Nat. Hist. Soc. ii, p. 19) says that one of these fish was found after a storm on Cromer beach in October, 1821. She made an accurate coloured sketch of this fish, which was full sized" (J. Southwell, MSS.). In 1844, Rudd (Zool. iii, p. 833) observed upon three from Redcar, all found on the beach during the autumn, and on December 2nd, 1850, two more were cast ashore at the same place (Zool. 1851, p. 3010). Mr. Dowell saw one in Norwich, January 25th, 1847, which was taken at Yadmo." In 1850 one was similarly thrown up at Norwich (Gurney, Zool. 1851, p. 3058), and during the same winter several were found in the Firth of Forth (Logan, Zool. p. 3058). October 24th, 1851, one taken in Gamrie harbour contained large ova, it was pushing its way inwards against a receding tide (G. Harris, Zool. p. 3301). R. Couch (Zool. 1846, p. 1406) says, "two specimens have been taken at Polperro, and the late Mr. Chirgwin informed me that one had been taken near the Runnel stone." July 4th, 1866, Mr. Clogg (Zool. p. 349) recorded one washed ashore at Liskeard. Buckland mentioned an example of 4½ lb. weight which he received from Northumberland in 1868. July 10th, 1874, Mr. Cornish remarked (Zool. p. 4266) that one was found nearly dead on the beach near Penzance, and he subsequently recorded that on June 12th, 1875, as a heavy gale was abating, one was captured in an exhausted state floundering about in the same locality, while in its stomach was a cuttle fish about 4 inches long (Zool. 1875, p. 4542). Edward states it to be rare in Banffshire: while Scouler considered it to be not uncommon on the

west coast of Scotland: and Parnell remarked that it has occurred frequently in the Firth of Forth, two or three specimens from thence being in the College Museum at Edinburgh.

In Ireland doubts have been cast upon the authenticity of McSkimmim's Carrickfergus specimen: Dr. Burkitt, of Waterford, gave an example taken at Tranmore, in October, 1843, to the Museum at Trinity College, Dublin.

For the example figured, 1/3 of the natural size, I am indebted to Dr. Hubrecht, of Leyden. It is said to attain to $2\frac{1}{2}$ feet in length. Yarrell mentions that one of those cast ashore at Redcar, in 1851, was $22\frac{1}{2}$ inches long.



SCHEDOPHILUS MEDUSOPHAGUS.

Genus II.—Lampris, *Retzius.*

Chrysostosus, Lacépède.

Branchiostegals seven. Body oval, elevated, and compressed. Mouth terminal, protractile, and with a shallow cleft. Opercular pieces entire. Teeth absent from the mouth. A single, many-rayed, dorsal fin destitute of spines: anal with less rays than the dorsal and also spineless. Ventrals elongated and many rayed. Scales small and very deciduous. Air-bladder large and bifurcated posteriorly. Pyloric appendages numerous.

Geographical distribution.—This beautifully tinted pelagic form is found in the seas of Norway and extending in the Atlantic certainly so far as Madeira: occasional examples are also captured in the Mediterranean.

1. Lampris luna, Plate XLII.

Sibbald, Scotia Illus. pl. vi, f. 3; Wallace, Orkneys, p. 37; Mortimer, Phil. Trans. xlvi, p. 518, t. iv. *Zeus cauda bifurca*, Stroem, Sœndmer, i, p. 323, t 1, f. 20; Müll. Prod. Zool. Dan. p. 44, No. 370. *Opah*, Penn. Brit. Zool. (Ed. 1) iii, p. 223, pl. xlii (Ed. 2), iii, p. 299, pl. xlvi. *Zeus Strœmii*, Walb. Artedi, iii, p. 398. *Poisson lune*, Duhamel, Pêches, iii, p. 74, t. xvii. *Zeus regius*, Bon. Ency. Méthod. p. 72, f. clv. *The Opah*, Low, Fauna Orcad. p. 208.

Scomber pelagicus, Gunner, in Dronth. Selsk. Skr. iv, p. 80, t. xii, f. 1.

Zeus luna, Gmel. Linn. p. 1225; Bl. Schn. p. 96; Donovan, Brit. Fish. v, pl. 97; Sowerby, Brit. Misc. pl. xxii; Turton, p. 95.

Zeus guttatus, Brünn. Nya. Saml. Danske Vid. Selsk. Skr. 1788, iii, p. 398, t. A; Holten, Nat. Selsk. Skr. v, p. 129; Faber, Fische Islands, p. 132; Richardson, Fauna Bor. Amer. Fishes, p. 83.

Zeus opah, Pennant, Arct. Zool. Suppl. p. 419; Shaw, Zool. iv, p. 287, pl. xlii.

Lampris guttatus, Retzius, Nov. Mém. Acad. sc. Suede, 1799, t. xx, pt. 3, p. 91; Holten, Zool. Dan. iv, t. 144; Cuv. and Val. x, p. 39, pl. cclxxxii (*Young*); Cuv. Règne Anim. Ill. Poissons, pl. lxi; Yarrell, Brit. Fish. (Ed. 1) i, p. 173, c. fig. (Ed. 2) i, p. 194 (Ed. 3) ii, p. 263; Parnell, Fish. Firth of Forth, p. 63, pl. 27, and Wern. Mem. vii. p. 223, t. xxvii; White, Catal. Brit. Fish. p. 38; Swainson, ii, p. 251; Gaim. Voy. Groënl. Zool. Poissons, pl. x; Schlegel, De Dieren v. Neder. p. 12, pl. i, f. 5; Collett, Norges Fiske, p. 48; Winther, Ich. Dan. 1879, p. 15.

Scomber gunneri, Bl. Schn. p. 38.

Chrysotosus luna, Lacép. iv, p. 586, pl. ix, f. 3.

Zeus imperialis, Shaw, Nat. Misc. iv, pl. cxl and Zool. iv, p. 289, pl. xlii.

Lampris luna, Risso, Eur. Mérid. iii, p. 341; Flem. Brit. An. p. 219; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Jenyns, Manual, p. 369; Thompson, Nat. Hist. Ireland, iv, p. 96; Günther, Catal. ii, p. 416; Steind. Ich. Span. u. Port. 1868, p. 31; McIntosh, Fish. St. Andrew's, p. 174; Giglioli, Catal. Pesc. Ital. p. 27; Moreau, Poiss. France, ii, p. 484.

Lampris lauta, Lowe, Trans. Zool. Soc. ii, p. 183, iii, p. 6, and Proc. Zool. Soc. 1839, p. 80, and Fish. Madeira, p. 27, t. v; Gray, Ann. and Mag. (3) 1861, p. 192; Lowe, Fauna of Norfolk, p. 11.

Opah, Couch, Fish. Brit. Isles, ii, p. 133, pl. xciii.

B. vi-vii, D. 53-55, P. 24, V. 14-16, A. 38-41, C. 22, Vert. 20-24/21-22.

Length of head $3\frac{3}{4}$ to 4, of caudal fin $4\frac{3}{4}$ to 5, height of body $2\frac{1}{4}$ to $2\frac{2}{3}$ in the total length. *Eye*—placed slightly above the middle of the height of the head, diameter 4 to $5\frac{1}{2}$ in the length of the head, $1\frac{2}{3}$ diameters from the end of the snout. Head a little higher than long, with the profile over the eye slightly concave. Jaws nearly equal anteriorly: the posterior extremity of the maxilla does not extend so far as to beneath the eye. *Teeth*—Jaws and palate toothless. *Fins*—the dorsal commences over or slightly behind the base of the pectoral: in

the adult the anterior fourth is elevated, whereas the rays in the remainder of the fin are short, except the last few, which are slightly longer, and when laid flat extend to the base of the caudal fin. Pectoral falciform, inserted about the centre of the height of the body, and reaching to beyond the middle of the base of the dorsal fin. Ventral situated rather posterior to the base of the pectoral but similar to it in shape and length. Anal low, commencing on a vertical line below the middle of the dorsal fin. Caudal forked. *Lateral-line*—with a strong curve, becoming straight about midway between the eye and the base of the caudal fin: it is formed of short single unbranched tubes. Free portion of the tail as high as long. *Air-bladder*—very large, rounded in front and ending posteriorly in two short horns. *Colours*—this fish is an exception to the general rule that those which inhabit the tropical seas are most resplendent in colours, as none can surpass the *Opah:* as a French naturalist observed, it resembles a noble of Neptune's court attired in his gala apparel. Back bluish-green, sides violet and becoming red beneath: a number of oval silvery spots scattered over the whole of the body and upper surface of the head: fins and tail bright red. The general colours, however, vary from silvery-green to bright golden with azure reflections.

In Cuv. and Val. l. c. reference is made to a young example of this fish captured in the Gulf of Gascogne in 1810. The forms of the body, the various proportions, the curvature of the lateral line and the spots were the same as in adults. But the ventral fins equalled more than half the length of the body, their extremities reaching to the middle of the caudal: while the anterior portion of the dorsal fin was equally long. The pectorals likewise were proportionately larger than seen in large specimens. This fish is figured in C. V. l. c.

Names.—*Opah, King-fish, sea-pert, carf, Jerusalem haddock, sun-fish. Brenhinbyog*, Welsh. *Koningsvisch*, Dutch. *Chrysotose*, French.

Habits.—This fish is a resident of deep waters, but rarely coming to the shallows in the British seas: it has been recorded as captured in February, March, the early summer, June, July, August, November, and December, while in the majority of cases the month has not been mentioned. It may be taken, in short, at any time throughout the year. In the stomachs of such as have been examined, cuttle-fishes, other cephalopods, and Acalephæ have been obtained.

Means of capture.—Low observes that it is very rare in the Orkneys, never caught with a hook, and seldom thrown on shore. Mr. Dunn observed his example floating on its side close in shore: it obtained an entrance into a sort of open drain into which the tide flowed. He seized it by the tail but was unable to lift it: another fisherman also tried to raise it at the same time, seizing it by the gills. The fish at once broke loose, inundating them by its splashings. Finally it was quietly dragged by its tail up the drain when it dashed against the iron shutter which closed the drain exit, and so became stunned. It weighed 3/4 of a cwt.

As food—Wallace observes that the flesh of the anterior half was like beef and the other half like salmon. The one washed ashore in 1835, at Queensferry, was eaten, its flesh was red and said to resemble and to be as good as salmon. Moreau likewise remarks of an example at Boulogne, in July, 1878, that its flesh was served at many tables and found to be excellent.

Habitat.—It seems to prefer the deeper waters of the North Sea, and merely ranges throughout a limited space, while it has not been recorded off Greenland or east of North Cape. The largest number taken have been in the north. It has been captured, according to Nilsson, on the coast of Norway from immemorial ages, and was described by Peder Claussen in 1632 as *Laxetoy*, or "large salmon." His example weighed 140 lb. In Scandinavia it is known as *Glans-fisk*. Very rare in the Mediterranean, it is, however, sometimes captured there. Professor Giglioli mentions two taken in Italy.

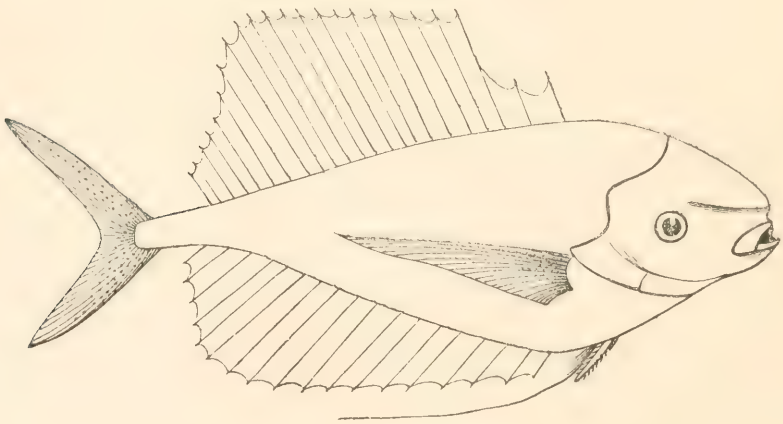
Among those captured in British waters, we find many recorded. Sibbald obtained one from the Firth of Forth in 1664: Wallace from Sunda in the Orkneys in 1682, when he observes upon several which had been previously got there. Upwards of a dozen specimens, observes Baikie (Zool. 1853), have been

procured at different times in the Orkneys and Zetland, and one nearly 6 feet in length was captured in Sanday. Mortimer, in 1750, exhibited at the Royal Society one taken at Leith. It is scarcely necessary to enumerate all the various captures, a long list of which may be seen in the Thirty-ninth Annual Report of the Royal Cornwall Polytechnic Society for 1869, p. 76. Pennant records two from Scotland, and in 1769, one 3 feet 6 inches long, and weighing 70 or 80 lb., was taken in Northumberland, and described by Harrison in the British Zoology. One in Filey Bay, Yorkshire, 3 feet 5 inches long, and in 1772 one, 4 feet 5 inches long and weighing 140 lb., at Brixham. Paget recorded one in December, 1823, and another in November, 1828, captured at Yarmouth: and Scouler one from the Clyde in 1833. In 1835, during the early part of the summer, one was taken in the west of Cornwall, and in August the same year another near Conway (Couch): and in July, 1839, one at Hunstanton, on the east coast of Norfolk, which was placed in the Wisbeach Museum. March 3rd, 1839, one was taken at Port Gordon, near Elgin, 3 feet 10 inches long, weighing 112 lb. (Gordon, Zool. 1852, p. 3459), and several years subsequently another from near Nairn. In 1844, on July 4th, Mr. Gurney (Zool. p. 679) recorded one at Norwich which had been left by the tide on the beach at Eccles, it was a male weighing 4 or 5 stone. Norman mentions one taken in February, 1849, at Flamborough Head: and in 1850, another weighing 72 lb. at Redcar (Rudd, Zool. ix, 1851, p. 3010). Several others have been recorded from Scotland and the west of England, and Edward states it to have been taken in Banffshire on several occasions. A local example is in the St. Andrew's Museum (McIntosh). In June, 1865, a large specimen was taken in St. Austell's Bay, Cornwall.

In Ireland we find one recorded in Sampson's Derry (p. 337), which was sent to the Dublin Society: in 1835 one was taken in June in the Foyle (Ordnance Survey). In October, 1842, one was sent from Tramore to the Dublin University Museum: and in June, 1849, one weighing 55 lb. was taken in Derry (Derry Standard): in August the same year, another at Wexford, weighing 59 lb. In July, 1850, one from Belfast Bay, and in 1851, one from Skerries, now in the University Museum.

The figure is taken from the stuffed example in the British Museum.

The size to which it attains is questionable, but it has been recorded up to 6 feet in length.



LUVARUS IMPERIALIS (*young*).

Genus 3.—LUVARUS, *Rafinesque.*

Ausonia, Risso. *Proctostegus*, Nardo. *Diana*, Risso (*young*). *Astrodermus*, Cuv. and Val. (*young*).

Branchiostegals five: pseudobranchiæ present. Body oblong, anteriorly enlarged, but compressed and much decreased in size in its posterior two-thirds. Mouth small and terminal. Teeth in a fine row in the jaws: also on palatines and tongue in the young. A single rayed dorsal fin situated in the last half of the length of the back in adults, but about one-third longer in the young. Ventrals thoracic, which in the young may possess an entire or serrated spine. Anal fin nearly similar to dorsal. Caudal forked. A longitudinal keel along either side of the root of the tail in adults. Opening of vent below origin of pectoral fin. Scales rudimentary. Air-bladder large. Cœcal appendages few.

The dorsal fin is very curious, as the remains of a part of the anterior portion which exists in the young is sometimes perceptible in the adult. The bones of this fish are of a very soft consistence.

Professor Giglioli has shown most conclusively that *Diana semilunata*, Risso, is the immature of this fish. Such a modification is exceedingly remarkable (see figure, p. 120).

Geographical distribution.—Pelagic fishes found in the Mediterranean, and occasional wanderers extend their range to the southern shores of the British Isles, and even to Madeira.

1. **Luvarus imperialis**, Plate XLIII.

Luvarus imperialis, Rafin. Carat. Gen. 22, Spe. 53, Ind. Itt. Sicil. p. 39, No. 290, pl. i, f. 1; C. Bonap. Catal. No. 700; Cuv. and Val. ix, p. 412; Giglioli, Catal. Faun. Ital. p. 26; Moreau, Poiss. France, ii, p. 511.

Ausonia Cuvieri, Risso, Eur. Mérid. iii, p. 342, f. xxviii; Lowe, Proc. Zool. Soc. 1843, p. 84; C. Bonap. Catal. No. 699; Günther, Catal. ii, p. 414, and Proc. Zool. Soc. 1866, p. 336, c, bad fig. of skeleton; Canestr. Fauna Ital. p. 108; Couch, Proc. Zool. Soc. 1866, p. 332, c. fig.; Steind. Ich. Span. u. Port. 1868, p. 31.

Proctostegus prototypus, Nardo, Mem. "De Proctostego" Patavii, 1827, c. fig.

Ausonia Cocksii, Couch, Ann. and Mag. Nat. Hist. 1866, xviii, p. 424, and Cornish Zool. 1866, p. 500; W. Bullmore, Journ. Royal Inst. Cornwall, 1866, No. vi, p. 61, c. fig.

(*Young.*)

Coryphæna elegans, Risso, Mém. prés. l'Inst. 1814.

Diana semilunata, Risso, Eur. Mérid. iii, p. 267, t. vii, f. 14; Günther, Catal. ii, p. 413; Steind. l. c. p. 30.

Astrodermus coryphænoides, Cuv. and Val. ix, p. 353, pl. cclxx; Swainson, ii, p. 255; Lowe, Proc. Zool. Soc. 1840, p. 37, and Trans. Zool. Soc. iii, p. 7.

Astrodermus Valenciennessi, Cocco, Giorn. Sc. Lett. Art. Sic. f. 153, c. fig.

Astroderma plumbeum, Lowe, Pro. Zool. Soc. 1843, p. 83.

Astrodermus elegans, Bonap. Faun. Ital. Pesci. No. 701, c. fig.; Canest. Faun. Ital. p. 108; Moreau, Poiss. France, ii, p. 514.

B. v, D. 1/11-13 (22-23 *in the young*), P. 14-18, V. 1/4, A. 1/14 (18 *in young*), C. 16, Cœc. pyl. 5, Vert. 20 (Nardo), 11/11 (Günther).

Length of head $4\frac{1}{2}$ to 5, of caudal fin $5\frac{1}{4}$, height of body 4 to $4\frac{2}{3}$ in the total length. *Eye*—small, situated nearly in the middle of the height of the head, 6 to 7 diameters in the length of the head, 2 diameters from the end of the snout. Mouth not protractile, terminal, with the lower jaw prominent, the extent of the gape scarcely exceeding that of the diameter of the eye, while the

cleft hardly extends one-third of the distance to beneath the orbit. A high interparietal crest; also a hard ridge, giving the appearance as if a furrow extended from the forehead to the base of the pectoral fin. *Teeth*—a fine row in the jaws in adults: also in the young some deciduous ones on the palatines and on the tongue. *Fins*—in the adult the dorsal fin is low and situated in the last half of the back not extending to the caudal fin, the rays are mostly simple and low, sometimes a short spine has been observed before this fin (in the *young* the dorsal fin commences much further forwards, and the rays, 22 to 23, are higher). Pectoral falciform. Ventral in adults may be absent, according to Nardo, or consist of from one spine and four branched rays to simply two rays: it is situated under the base of the pectoral fin: in the *young* the spine may be serrated on both edges or entire, while one of the rays is very elongated (see figure, page 120). Anal reaching to as far as the dorsal, and shorter, but otherwise similar to it in both adults and young. Caudal forked. A well-marked longitudinal keel along either side of the root of the tail, and two transverse crests as in tunnies. *Scales*—Lowe, l. c. observes that in his adult example, 35 inches long, the whole body was smooth and scaleless: with the exception of irregular patches here and there, most plentiful on the head and back, of a skinny, crape-like coat or covering of minute, rough, branny scales, like a crust of half-congealed snow, and easily rubbed off. Where this was absent he considered such to have been the result of natural wear or injury. A valve exists at the vent. *Colours*—those of Mr. Cornish's adult example were as follows. Back, steel-gray, having a broad scarlet band along the side, and below this a silvery abdomen. The sides appeared as if sprinkled with gold dust. Fins bright crimson. In Mediterranean examples the back has been observed to be golden, the sides white tinged with blue, and the under surface white. Fins mostly red: caudal golden at its base, becoming silvery at its extremity. Ventrals brownish. The *young* are silvery, with blackish spots: the dorsal and anal fins dark, whereas the others are yellow stained with red.

The male fish is said to have the anterior dorsal rays prolonged.

Habits.—These are scarcely known: the young have been captured near the surface at sea. Its intestines would seem to point to its being a vegetable feeder, which probably does not live at any great depths in the ocean.

Breeding.—Risso observes on having found a female *Diana semilunata*, full of eggs in the summer.

As food.—Nardo observed that it resembled beef, and its flavour was excellent.

Habitat.—This fish is found, though rarely, in the Mediterranean, and has been occasionally obtained on the Italian and Sicilian coasts, a large female example having been captured at Venice in 1839: it has been also mentioned from other localities, as from Malta, Nice, and Cetti, in which last place one was taken August 3rd, 1875.

The first recorded British example was thrown on shore at Deadman, on the south coast of Cornwall, on April 30th, 1866, and was secured by Mr. Dunn, who dispatched it to Couch. At the time of its capture a strong breeze was blowing, and the waves were rough. This specimen is now in the British Museum, and is the one from which I figured plate xliii. It measured 3 feet 9 inches from the snout to the fork of the tail. The second example was taken at Falmouth, September 30th, 1866, while floundering in a pool left by a receding tide. A fisherman seized it by the tail, and was towed about by the fish until it was tired. It measured 4 feet in length and weighed 120 lb.

Rafinesque's example captured June, 1808, in Sicily, was 5 feet long.

Family, XII—CARANGIDÆ, *Günther.*

Scomberoidei pt. et *Squamipinnes*, pt. Cuvier: *Scombrioidæ*, pt. Richardson.

Branchiostegals seven, occasionally less: pseudobranchiæ present (absent in *Lichia* and *Trachynotus*). Body oblong, elevated, or sub-cylindrical and compressed. Gill-openings wide. Eyes lateral. No bony articulation between preopercle and infraorbitals. Dentition varied: teeth, when present, conical. Base of spinous dorsal of less extent than the rayed portion, and occasionally formed of isolated spines: sometimes detached finlets at the end of dorsal and anal fins. Anal spines, when present, may or may not be continuous with the fin. Ventrals, when present, thoracic, sometimes rudimentary. Scales usually small or absent. Lateral-line may be partially or entirely armed with shield-like plates. Air-bladder present. Pyloric appendages usually numerous. Vertebræ 10/14 (*Naucrates* 10/16).

The young of many genera of fishes of this family have the head variously armed, but such armature is absorbed before they reach the adult age.

Geographical distribution.—From as far north as Denmark and Sweden, through most of the temperate and tropical seas of both hemispheres.

Genus I.—Caranx, *Lacépède.*

Trachurus, *Olistus*, *Blepharis*, *Gallichthys*, *Scyris*, and *Hynnis*, Cuv. and Val.; *Trachinus*, Swainson; *Megalaspis*, *Decapterus*, *Selar*, *Carangichthys*, *Carangoides*, *Leioglossus*, *Uraspis*, *Selaroides*, *Gnathanodon*, and *Hemicaranx*, Bleeker; *Carangus*, Girard; *Trachurops*, *Carangops*, and *Paratractus*, Gill.

Branchiostegals seven: pseudobranchiæ present. Body oblong, sub-cylindrical, and more or less compressed. Cleft of mouth of moderate depth. Eyes lateral, with or without adipose lids. Teeth generally weak. Two dorsal fins: the first continuous, having about eight weak spines, which are sometimes rudimentary, at its base anteriorly is a recumbent, forwardly-directed spine: the second dorsal of greater extent than the first and similar to the anal: sometimes the last rays of both these fins are semi or wholly detached: two pre-anal spines which occasionally are rudimentary, they are separated by an interspace from the anal fin. Scales minute. Lateral-line with an anterior curved portion, while the posterior is straight and covered with large plate-like scales which are usually keeled and sometimes spinate, these may be continued on to the anterior curved portion of the lateral-line (Trachurus). Air-bladder bifurcated posteriorly. Pyloric appendages in large numbers.

Considering the numerous species and varieties of form which are found in the genus it is not surprising that many sub-divisions of it have been proposed. The characters employed for this purpose have been the dentition, the form of the fins, the serrations or the reverse of the preopercle, and the armature of the scales on the lateral-line, the scales on the body, and the adipose eyelids. But the single British species is well characterized by its entire lateral-line being armed with large keeled plates.

Geographical distribution.—The fishes composing the genus *Caranx*, or "Horse-mackerels," are spread from Norway and Sweden throughout most of the temperate and tropical seas, more especially abounding in the latter, where they attain to a large size, and are not considered unsuitable for the table: though some have been reported as poisonous at certain times in particular localities in the tropics, probably due to the food on which they have been living.

Caranx trachurus, Plate XLIV.

Τραχούρος. Athen. vii, p. 326; Oppian, Halieut. i, p. 5.

Saurus, Salv. fol. 79, pl. xv. *Lacertus seu Trachurus*, Belon. p. 133. *Lacertus Belonii*, Gesner, pp. 467, 552. *Trachurus*, Rondel. viii, c. 6, p. 233, c. fig. *Museken*, Schon. p. 75; Aldrov. ii, c. 52, p. 268; Jonston, De Pisc. lib. i, tit. iii, c. 3, Art. 1. p. 94, tab. xxi, f. 8; Ray, p. 92. *Scad*, Willughby, p. 290, t. S. 22; Pennant, Brit. Zool. (Ed. 1) iii, p. 269, pl. li (Ed. 1812), iii, p. 363, pl. lxii. *Scomber*, No. 3, Artedi, Gen. p. 31. *Scomber*, Sp. Gronov. Zooph. p. 94, No. 308, and Mus. Ich. i, p. 34, No. 80; Duhamel, Pêches, ii, Sect. 7, p. 188, pl. i, f. 2.

Scomber trachurus, Linn. Syst. i, p. 494; Bloch, t lvi; Gmel. Linn. p. 1335; Bonnat. p. 140, pl. lviii, f. 230: Bl. Schn. p. 27; Pallas, Zoogr. Ross. iii, p. 208; Donovan, Brit. Fishes, i, pl. iii; Turton, p. 101.

Caranx trachurus, Lacép. iii, p. 60; Risso, Ich. Nice, p. 173, and Eur. Mérid. iii, p. 421; Cuv. and Val. ix, p. 11, pl. 246; Jenyns' Manual, p. 366; Yarrell, Brit. Fish. (Ed. 1) i, p. 154, c. fig. (Ed. 2) i, p. 175 (Ed. 3) ii, p. 236; Bonap. Pesc. Eur. p. 75; Gay, Hist. Chile, Zool. ii, p. 233; Cuv. Règne Anim. Ill. Poiss. pl. lvii, f. 1; Richards. Ich. China, p. 273, and Ann. and Mag. Nat. Hist. 1843, xi. p. 25; Templeton, Mag. Nat. Hist. 1837 (2), i, p. 409; Parnell, Fish. Firth of Forth, p. 57, and Wern. Mem. vii, p. 217; Johnston, Berwick. Nat. Club, 1838, i, p. 171 Nordm. in Demid. Voy. Russ. Mérid. iii, p. 393; Guichen. Explor. Algér. Poiss. p. 61; White, Catal. Brit. Fish. p. 37; Thompson, Nat. Hist. Ireland, iv, p. 95; Schlegel, De Dieren Nederland, p. 8, pl. i, f. 2; Collett, Norges Fiske, p. 50; Winther, Ich. Dan. 1879, p. 15.

Caranx omorus, Lacép. iii, pl. xi, f. 1.

Caranx amia, Risso, Ich. Nice, p. 174.

Trachinus spinulosus, Swainson, Fishes, ii, p. 249.

Seriola picturata, Bowd. Exc. p. 123, f. xxvii.

Trachurus vulgaris, Flem. Brit. An. p. 218; Johnston, Fish. Berwick. Mag. Nat. Hist. vi, 1833, p. 15.

Trachurus Europeus, Gronov. ed. Gray, p. 125.

Caranx trachurus, var. *Japonicus*, Temm. and Schleg. Fauna Japon. Poiss. p. 109, pl. lix, f. 1.

Selar Japonicus, Bleeker, Japan. pl. viii, f. 1.

Caranx symmetricus, Ayres, Proc. Cal. Acad. Nat. Sc. i, 1855, p. 62.

Trachurus symmetricus, Girard, U. St. Pacif. R. R. Exped. Fish. p. 107.

Caranx Cuvieri, Lowe, Trans. Zool. Soc. ii, p. 183.

Caranx declivis, Jenyns, Zool. Beagle, Fishes, p. 68, pl. xiv.

Trachurus trachurus, Casteln. Anim. Nouv. ou rares Poiss. p. 23; Günther, Catal. ii, p. 419; Kner and Steind. Sitz. Ak. Wiss. Wien, liv, p. 364; Kner, Novara Fische, p. 150; McIntosh, Fish. St. Andrew's, p. 174; Giglioli, Pesci Ital. p. 27; Moreau, Poiss. France, ii, p. 437.

Scad, Couch, Fish. Brit. Isles, ii, p. 136, pl. xciv.

B. vii, D. $8/\frac{1}{31-33}$, P. 19-21, V. 1/5, A. $2/\frac{1}{26-29}$, C. 17, L. l. 73, Cœc. pyl. 12. Vert. 10/14.

Length of head 4 to $4\frac{1}{2}$, of caudal fin 5 to $5\frac{1}{3}$, height of body 5 to $5\frac{1}{4}$ in the total length. *Eye*—situated above the middle of the height of the head, it has a wide posterior adipose lid extending nearly or quite to the edge of the pupil, and also a much narrower anterior adipose lid. Diameter of eye from $3\frac{1}{2}$ to $3\frac{2}{3}$ in the length of the head, from 1 in the young to $1\frac{1}{2}$ diameters in the adult from the end of the snout, and nearly 1 diameter apart. Interorbital space flattened, with a rather sharp ridge running down its centre. The lower jaw the longer: the maxilla reaches to beneath the first third of the eye. Preorbital much narrower posteriorly than it is anteriorly. Free portion of tail wider than deep. *Teeth*—minute in the jaws, also on the vomer, palatines, and in a band along the middle of the tongue. *Fins*—dorsal spines weak, increasing in length to the 4th and 5th, subsequent to which they decrease, a short interspace between the two fins, the second being much lower than the first and similar to the

anal. Pectoral sickle-shaped, nearly or quite as long as the head. Ventral not extending to the vent. Second pre-anal spine the strongest. Caudal rather deeply forked. *Scales*—very small, present on cheeks, opercles, summit of the head, and over the body. *Lateral-line*—makes a curve to beneath the first third of the second dorsal fin, in the curved portion of its course it is crossed by large scale-like plates, deeper than wide, which become more indistinct in the adult: in its straight portion these plates, 34 to 40, are keeled, becoming most strongly so posteriorly. The number of these plates is subject to great variation, thus in Cuv. and Val. it is observed that such varied from 70 to 99, in examples examined in Paris. *Air-bladder*—M. Moreau (Compt. Rend. lxxx) observes that an opening exists permitting the escape of gas from this organ into the bronchial cavity, but does not admit atmospheric air. *Cœcal appendages*—elongated, and about twelve in number. *Colours*—of a dark bluish along the back and so low as the lateral-line, beneath which it becomes silvery, glossed with purple and gold. A diffused black spot on the opercle.

Varieties.—Edward remarks that he once found a rather strange variety of this species in Banffshire. It was about the usual size, but of a most beautiful golden colour, finely striped and variegated with numerous lines of the brightest blue, except the fins, which were of the finest carmine.

Names.—*Scad*, *horse-mackerel*, which term is said to denote the inferior quality of its flesh: *buck-mackerel* (Banff). *Macrell y Meirch*, Welsh. *Le saurel*, French. *Hors*, Dutch.

Habits.—Adults are more solitary in their habits than are the young, and they swim low in the water: in the colder months they retire to the deeper water, re-appearing on our coasts about April, when they become one of our commonest fish. They are, however, very uncertain in their migrations, perhaps from a great sensibility to cold and vicissitudes of temperature. Thus Parnell observes that in 1833 and 1834 scarcely an example was observed in the Firth of Forth, while they were in prodigious numbers on the English and Welsh coasts. Off Glamorganshire on the evening of July 24th, 1834, the whole sea as far as could be seen, appeared to be in a fermentation from their numbers. These immense shoals continued passing up channel for a week. Devoured themselves in large numbers by sea birds, they are great enemies to pilchards, the herring-fry, and the sand-launce, &c. Thompson found young *Clupeidæ* in one he opened in August. Ball states that he has seen the "scad" run up on shore in considerable numbers, but whether in pursuit of young sprats termed *scad-bait* or to avoid porpoises, *Delphinus phocæna*, which were conspicuous in their rear, he was unable to say. In Norfolk, Mr. Upcher observed that he had frequently seen large numbers of the scad in chase of small fry along the coast at Sherringham, and so intent in the pursuit as to be easily taken with a landing net. The beach was quite covered with small fish which were stranded on the shingle after leaping from the water to escape their pursuers. R. Couch has observed that the "mackerel" and "scad" do not intermingle much except near the Scilly Isles, where they are frequently caught together in large quantities. North of this the mackerel predominate, to the south the scad, and it is surmised that in the winter months the shoals of scad are to the south of those of the mackerel, the borders of the two intermingling. They pass up the channel during the spring in the deep water, feeding at the bottom, but as summer advances they approach the shore, swimming high, and these are frequently taken by mackerel-nets as well as by hooks and lines. Sir T. Browne remarks that in Norfolk "before the herrings there commonly cometh a fish about a foot long, by fishermen called a *horse*, resembling in all points the *Trachurus* of Rondeletius."

Means of capture.—As many as 20,000 have been taken off Cornwall in a net at one time. In September and October they are captured in numbers in the Cornish pilchard nets: some are taken in the salmon nets in the Firth of Forth.

Baits.—Large ones readily take a bait.

Breeding.—June, July, and August (but in the Mediterranean during the spring, according to Risso). In September the bays in Cornwall swarm with the young of about 1 inch in length, by October numbers scarcely exceeding 2 inches

in length are captured, while others are 7 or 8 inches. Scad about 1 inch long are commonly taken from the stomachs of large fish from the end of December to the middle of February. Couch, from these facts, suggested whether they do not breed twice a year; or perhaps all do not breed at the same time. He also observed that the young have sometimes an unfortunate fate: coming to the surface to obtain heat, they are huddled together, when guillemots dive down to beneath them and gulls dart down from above.

Uses.—In West Cornwall and the Scilly Isles they are split and dry salted: also in the north of Ireland, where they are known as *crake-herrings.*

As food.—Pennant says the one 16 inches long which he had, taken in October, was firm and well-tasted, having the flavour of mackerel. It is in best season when it first comes off the coast in April. Generally it is but little esteemed, and is held in no higher estimation in Ireland, according to Thompson, but Ball states that on the south coast it is much valued by the poor.

Habitat.—This fish has been taken off Denmark and the west coast of Norway, but is not common in the Baltic: as we pass further south their numbers increase, while they are very common in the Mediterranean. Found at Madeira, they range to the Cape of Good Hope, and have been brought from the Chinese and Australian seas: also from Western America, Steindachner having received them from Valparaiso, while others have been obtained on the same coast.

Very common on all parts of the Cornish seas, disappearing in October, but numbers of the young are taken until spring. It is found all round the coasts of Great Britain: frequent off Lowestoft, rare off Yarmouth, while it has been recorded from Berwickshire. In Scotland, Gordon (Zool. 1852, p. 3459) remarks on it having been taken in the Moray Firth; a few every year at Lossiemouth, while it has been met with at Nairn. Parnell observes that in the Firth of Forth seldom more than 1 or $1\frac{1}{2}$ dozens are taken during the year. Edward says that in Banffshire it is not very numerous, and is seldom eaten: McIntosh, that it is not uncommon at St. Andrew's; and Baikie that it is tolerably common in the Orkneys and Zetland.

In *Ireland* it is taken around the coast, but in larger numbers on the southern and western shores than on the northern or north-eastern. Moore records it from Kerry.

The example figured, life size, was from the south coast: it attains to about 20 inches in length. Dr. Lowe mentions one he saw taken in the Norfolk estuary, which weighed 2 lb.

Genus 2.—NAUCRATES, *Cuvier.*

Nauclerus, Cuvier (*young*). *Xystophorus*, Richardson (*young*).

Branchiostegals seven: pseudobranchiæ present. Body oblong, sub-cylindrical. Cleft of mouth of moderate extent. A spine at the angle of the preopercle in the young, which becomes absorbed as age increases. Villiform teeth in the jaws, vomer, and palatine bones. The first dorsal fin, which is continuous in the young, becomes reduced to a few free spines in the adult: the second dorsal and anal many rayed: no spurious fins or finlets: in the young two pre-anal spines remote from the anal fin but which becomes absorbed with age. Scales small: lateral line unarmed. A keel on either side of the free portion of the tail. Air-bladder present. Pyloric appendages in moderate numbers.

Ælian tells us that these fishes were supposed to be kindly disposed towards sailors, and therefore liked to approach ships, which they continued with until they approached the land. They were deemed sacred to Neptune, the god of the ocean, who protected them from designed injury, consequently a man who had ventured to eat one soon afterwards lost his son by drowning. That these fishes will accompany vessels long voyages has been frequently observed, thus two came from the Mediterranean to Falmouth (see Linn. Trans. Vol. XIV). They do not appear to like the cold water of the English Channel. Edward has recorded the capture of one as far north as Banffshire, and Dr Harvey its occurrence off the county of Cork.

Geographical distribution.—This pelagic fish is extensively spread through most temperate and tropical seas.

1. Naucrates ductor, Plate XLV.

Πόμπιλος, Ælian, ii, c. 15, xv, c. 23; Athen. vii, p. 282; Oppian, i, p. 188.

Pompilus, Ovid, Hal. v, 101; Pliny, ix, c. 15, xxxii, c. 11; Gesner, p. 881; Aldrov. iii, c. 19, p. 325; Willugh. p. 215, Append. pl. viii, f. 2. *Pilote*, Dutertre, Hist. Antilles, ii, p. 223; Ray, p. 156. *Scomber*, sp. Gronov. Zooph. No. 309; Koelreuter, Nov. Com. Pentrop. ix, p. 464, t. x, f. 4, 5; Duhamel, Pêches, ii, Sect. 4, pl. iv, f. 4, pl. ix, f. 3. *Coryphæna*, No. 3, Artedi, Genera, p. 16.

Gasterosteus ductor, Linn. Syst. i, p. 489; Brünn. Pisc. Mass. p. 67, Bennett, Whaling Voyage, ii, p. 274.

Gasterosteus antecessor, Dald. Skrivt. Nat. Selsk. Kjob. ii, p. 166.

Scomber ductor, Bloch, t, 338; Hasselq. Iter, p. 336; Gmel. Linn. p. 1324; Bl. Schn. p. 32; Mitchell, Trans. Lit. and Phil. Soc. New York, i, p. 424.

Scomber koelreuteri, Bl. Schn. p. 570.

Centronotus conductor, Lacép. iii, p. 311; Risso, Ich. Nice, p. 193, and Europ. Mérid. iii, p. 428.

Naucrates fanfarus, Rafin. Car. p. 44.

Naucrates ductor, Cuv. and Val. viii, p. 312, pl. ccxxxii; Yarrell, Brit. Fish. (Ed. 1) i, p. 149, c. fig. (Ed. 2) i, p. 170 (Ed. 3) ii, p. 227; Swainson, Fishes, ii, p. 245; Guichen. Exp. Sc. Algér. Poiss. p. 60; Cocks, Ann. and Mag. Nat. Hist. (2) 1856, xviii, p. 496; Thompson, Nat. Hist. Ireland, iv, p. 95; Günther, Catal. ii, p. 374, and Fische Sudsee, Heft, v, Dec. 1876, p. 137; Klunz. Verh. z. b. Ges. Wien, 1871, p. 445; Day, Fishes of India, p. 229, pl. liA, fig. 2; Giglioli, Catal. Pesc. Ital. p. 25; Lütken, Spolia Atlantica, p. 600, pl. iii, f. 14, 15; Moreau, Poiss. France, ii, p. 449.

Naucrates novemboracensis, Cuv. and Val. viii, p. 325.

Naucrates indicus, Cuv. and Val. viii, p. 326; Cuv. Règne Anim. Ill. Poiss. pl. liv. f. 1; Less. Voy. Coq. Zool. Poiss. p. 157, pl. xiv; Richardson, Ich. China, p. 269; Kner, Novara Fische, p. 145.

Naucrates koelreuteri, Cuv. and Val. viii, p. 327.

Nauclerus compressus, Cuv. and Val. ix, p. 249, pl. cclxiii; Günther, Catal. ii, p. 469 (*? young*).

Centronotus ductor, Couch, Trans. Linn. Soc. xiv, p. 82; Jenyns, Man. p. 365; White, Catal. Brit. Fish. p. 34.

Thynnus pompilus, Gronov. ed. Gray, p. 123.

Pilot-fish, Couch, Fish. Brit. Isles, ii, p. 107, pl. lxxxvii.

B. vii, D. 3-6 | $\frac{1}{26}\frac{1}{28}$, P. 19-21, V. 1/5, A. 0-2 | 16-17, C. 17, Cœc. pyl. 12-16, Vert. 10/16.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of pectoral fin 8, of caudal fin $5\frac{1}{2}$, height of body 4 to $4\frac{1}{2}$ in the total length. *Eye*—diameter 5 in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and 2 apart. The greatest width of the head equals 3/5 of its length, its height equals its length behind its posterior nostril. Jaws nearly equal in front or the lower slightly projecting, the maxilla reaches to beneath the front edge of the eye. *Teeth*—villiform in the jaws, in a pyriform band on the vomer, and in a long patch upon the palatines: tongue rough. *Fins*—free spines, composing first dorsal fin, all short: second dorsal fin highest anteriorly: anal commences below the 10th or 12th dorsal ray, it has generally two free spines anterior to it. Caudal forked. Pectoral as long as the ventral, which reaches two-fifths of the distance to the base of the anal. *Scales*—small and cycloid. *Lateral-line*—makes a gradual curve to above the first third of the anal when it is continued direct to the middle of the base of the caudal fin, forming a raised keel in the last portion. *Colours*—bluish, with five or six dark (in the live fish purplish-green) vertical bands, narrower than the ground colour. Fins gray, with three of the body bands continued on to the dorsal, which has also a white upper tip: and two bands on to the anal, which is similarly white tipped. The ends of each caudal lobe white with a dark base. Pectoral with a light outer edge.

Young, Plate XLV, fig. 2 (3/1), after Lütken.

These differ considerably from the adult, and have been placed in distinct genera. In Cuv. and Val. they form the genus *Nauclerus*, represented as having a continuous first dorsal fin and a spine at the angle of the preopercle. Sir J. Richardson in the Voyage of the Erebus and Terror, plate xxx, fig. 22, represents the very young under the name of *Xystophorus* (as pointed out by Lütken). It has spines on the supraorbital edge, at the angle and lower margin of the preopercle, and likewise along the lower edge of the interopercle. In an example I have from the Andamans, 9/10 of an inch in length, there is a strong spine at the angle of the preopercle and two along its lower edge: the others are almost lost.

Varieties.—A black form, *Scomber niger*, Bloch, t. cccxxxvii, has been observed.

Names.—*Pilot-fish*, a name which it has received from the propensities attributed to it by some authors, denied by others. *Le Pilote*, French.

Habits.—This fish has long been celebrated as the companion and the guide of sharks, as it was formerly said to be of whales, and also the friend, or at least close attendant, on ships while sailing over the ocean. Although some consider the pilot-fish to be the friend of the shark, others have thought such open to suspicion, while Cuvier has even suggested downright enmity or rather treachery in its actions. M. Geoffrey tells how two of these fishes were observed to lead a shark up to a baited hook which by their importunities they induced him to gorge. Or as Cuvier pithily puts it, that this tale if true should occasion them to be termed "deceivers" rather than "pilots." Captain Richards once observed upon a blue shark attended by four pilot-fishes following his vessel in the Mediterranean; a bait was displayed, but the little pilot-fishes pertinaciously came to the front and with their snouts thrust the baited hook away. All at last swam away together, but suddenly the shark changed its mind, turned and rushed forwards with all speed at the bait, leaving his faithful attendants far behind, and which only arrived as the body of their companion was being hauled up on board, to which one is said to have clung until it was half above water, when it fell off leaving it doubtful if it was not a sucking-fish (see p. 108 *ante*). Why the shark does not prey on its companions is a mystery. Lacépède thought their agility saved them, and that their flesh is not worth the eating.

In the Naturalists' Note-book (1869, p. 255), a writer (J. D. S. W.) mentions "we frequently threw pieces of flesh into the water to them. The pilot-fish first came up and smelt the meat, and then went away and led the shark to it, who always swallowed the whole and left none for his little companions. On a dark night you can see the entire shape of the shark in the water below, shining all

over with phosphorus. Now this phosphorus is considered by most naturalists to be animalcules, and if so, it may reasonably be presumed that the pilot-fishes live on them, for they are frequently seen clinging to the sides of the shark." Dr. Meyer considers it probable that the pilot-fish feeds on the shark's excrements, for which purpose it keeps it company, and is solely acted upon by selfish views. Couch tells us that in the solitary instance in which he had learnt that the pilot-fish had been found when alone at a considerable distance from any floating substance or harbour it seemed to be bewitched, dashed about close to the shore, and allowed itself to be captured by the hand. The probabilities are that the example was ill. They have not been observed accompanying sharks off the British coast.

Means of capture.—One has been taken with a hook and line. On vessels arriving at their port these fish have been secured with but little difficulty. Some of those obtained off the British coasts have been captured in mackerel nets.

Baits.—The stomach has been found full of small fish, and one example has been recorded which was taken on a baited hook.

Breeding.—As numerous fry are captured in the open sea it does not seem improbable that the spawn floats and is hatched there. I have an example of the young from the Andaman Islands taken close in shore.

As food.—Mr. Cornish states that he found one he ate to resemble a dry mackerel, a comparison which accords with my experience in the East.

Habitat.—Extending from the British Isles through the Atlantic to temperate and tropical seas. Rare in the British Channel, it is found throughout the Mediterranean: at Messina many are captured during the autumn, and although said to be rare at Marseilles, it is plentiful at Nice, especially about September. It is occasionally taken off the coast of America.

In 1818, one was taken in Dartmouth Harbour: in 1831, the "Peru" put into Plymouth from Alexandria, having been out eighty-two days, during the last eighty of which she had been accompanied by two of these fishes, which in Catwater, where the vessel anchored, became so tame as to be easily captured, when they were eaten and declared to be excellent. In October, 1833, nearly one hundred came with a vessel from Sicily into Catwater, but all escaped capture. In 1844, Dr. Shorter recorded one from Hastings, and Yarrell obtained another, but where it was taken is not mentioned. One was captured off the Isle of Wight in 1853, and on January 13th, 1855, a boy took three at Falmouth. A shoal made its appearance, observes Mr. Cocks, at the Customs' House Pier at Falmouth, October 31st, 1856, and more than three dozens were caught in nets, baskets, &c., by people on the beach. He observed that he had preserved specimens of this fish every year of his residence in the neighbourhood. Mr. Cornish (Zool. p. 9145) recorded an example taken at Penzance in June 8th, and another on the 14th October, 1868: Buckland received one taken off Folkestone in a mackerel net. June 27th, 1873, two were taken in mackerel nets about fifteen miles south-west of Penzance, consequently in the deep sea, and were supposed to have followed some vessel (Cornish, Zool. p. 3653). June, 1874, Mr. Cornish (Zool. p. 4080) recorded one from Penzance, and on November 9th, two were taken at Plymouth by a sailor in the Great Western Docks (Gatcombe, Zool. p. 4266): and one (Zool. p. 184), February 14th, 1877, in a herring net off Plymouth. Mr. Lee obtained one in December at Margate, a sailor seeing it basking hit it with a boat's stretcher, and brought it ashore. R. Couch says they are occasionally taken in Mount's Bay, but their presence can always be traced to the arrival of some foreign vessel. "Many years since I saw a specimen freshly caught on the Suffolk coast, and sent for preservation to the late Mr. J. Tims, of Norwich, in whose house it was unfortunately destroyed by a fire on the premises." (Gurney, in Lowe's Catal. of the Fishes of Norfolk.) Edward records a fine example in Banffshire, taken in the bay. In *Ireland* one was obtained in 1841 from Cookhaven, in the County of Cork (Dr. Harvey).

Genus III.—Pammelas, *Günther.*

Palinurus, De Kay: *Palinurichthys*, Gill.

Branchiostegals seven. Body oblong and rather compressed. Snout obtuse and swollen. Gape of mouth of moderate width: pre- inter- and sub-opercles serrated. Teeth in jaws in a single row: none on the palate or tongue. Two dorsal fins, the first consisting of six or seven free spines: anal with three spines, the first two being concealed by being nearly imbedded in the flesh. No finlets. Scales small, ctenoid, and extended over the bases of the vertical fins. Air-bladder divided by a constriction into two parts.

Geographical distribution.—Western coast of North America. A straggler has been taken off Cornwall, but in a manner which raises a question whether it ought or ought not to be included amongst the British fishes.

1. Pammelas perciformis, Plate XLVI.

Rudder-fish or *Perch coryphene*, Mitchill, Lit. and Phil. Soc. New York, i, pl. xvi, f. 7 (no description).
Coryphœna perciformis, Mitchill, Amer. Monthly Mag. ii, p. 244.
Trachinotus argenteus, Storer, Mass. Report, p. 55 (not Cuv.)
Palinurus perciformis, De Kay, New York Fauna, Fishes, p. 118, pl. xxiv, f. 25.
Pammelas perciformis, Günther, Catal. ii, p. 485.
Palinurichthys perciformis, Gill, Report Amer. Fisheries, 1873, p. 804.
Pimelepterus Cornubiensis, T. Cornish, Zoologist (2), ix, 1874, p. 4255.

B. vii, D. 6-7/$\frac{1}{22}$, P. 23, V. 1/5, A. 2/$\frac{1}{17-20}$, C. 21, L. l. 78, L. tr. 12/30.

Length of head 4, of caudal fin 6, height of body 3 to $3\frac{1}{4}$ in the total length. *Eye*—diameter $4\frac{1}{4}$ in the length of the head, $1\frac{1}{4}$ from the end of the snout, and $1\frac{1}{2}$ apart. Body elliptical and compressed. Preopercle finely serrated along the lower portion of its vertical limb, angle, and inferior limb: also on sub- and inter-opercles. Lower jaw slightly the longer: the maxilla reaches posteriorly to beneath the middle of the eye. The greatest depth of the body is below the commencement of the second dorsal fin. *Teeth*—in either jaw in a single row of equally sized ones placed a short distance asunder: none on the vomer, palatines, or tongue. *Fins*—the first dorsal, consisting of free spines, commences above the opercle: the length of the base of the second dorsal equals about one-third of that of the total length of the fish, it is low, the height of its rays scarcely exceeding one-fifth of the height of the body, and all of nearly equal length. Anal commences under the first third of the second dorsal, and is similar to it. Pectoral short, equalling the length of the head excluding the snout: ventral slightly shorter: caudal emarginate, or slightly lobed. *Scales*—small, ctenoid, covering the bases of the vertical fins: some also present on the cheeks and opercles. *Lateral-line*—makes a gradual curve in its anterior two-fifths, becoming straight from above the commencement of the anal fin. *Colours*—leaden, shot with purple over the back, occasionally becoming lighter on the abdomen. Head mottled with dark bluish spots, a row of them in the Cornish example being disposed round the upper and hinder part of the eye.

Names.—De Kay observes that it was termed *Trachinotus Cumberlandi* by Cozzens in a paper read before the Lyceum. De Kay calls it the *black pilot*, while the fishermen's name is *Snip-nosed-mullet.*

Habits.—De Kay observes that this fish is an occasional visitor to the shores of New York, where in 1815 several dozens followed a ship into the harbour, and one was captured by a hook at the wharves in the month of August. It is said to be exceedingly active, while numerous shrimps were present in the stomach of one which was opened. In the British example barnacles were found in its stomach.

Habitat.—Is found on the east coast of America from Maine to Cape Hatteras.

Off New York De Kay considered it to be common, while Storer noticed it on the coast of Massachussets.

The single British example was captured off Penzance, about six miles from shore, on October 9th, 1874, by the crew of a trawler. It was found alive in a wooden case, of which the bottom and sides were perfect but one board out of the three which had originally formed its top was absent. Although the fish was said to have been found in a good state of health, its proportions would seem to indicate its being thin, and perhaps somewhat starved. The specimen fortunately came into the possession of Mr. Cornish, of Penzance, who at once recognized it as being new to the British Fauna. It has been stuffed, and is now in the collection of Sir John St. Aubyn. When captured it was $14\frac{3}{4}$ inches in length.

The example figured is in the British Museum, and came from America.

Genus IV.—Lichia, *Cuvier.*

Porthmeus, Cuv. and Val. (*young*).

Branchiostegals eight: pseudobranchiæ absent. Body oblong and compressed. Cleft of mouth of moderate extent. Small teeth in the jaws, on the vomer, palatine bones, and tongue. Two dorsal fins, the first consisting of free spines, with an anterior one directed forwards: second dorsal low, with no finlets. Anal somewhat similar to second dorsal, and with two pre-anal spines. Scales small. Pyloric appendages in moderate or large numbers. Air-bladder present, bifurcated posteriorly.

Lütken, Spolia Atlantica, p. 600, observes that *Porthmeus argenteus* is the young of *Lichia amia* not of a *Chorinemus;* he considers *L. amia* as the type of a genus distinct from *Lichia*, terming it *Porthmeus amia.* He likewise observes on *L. calcar*, Bl., being the young of a *Chorinemus.*

Geographical distribution.—From the British Isles to Madeira and the Cape de Verd Islands, to the South Atlantic Ocean, from the coast of Africa to Brazil. A species has been recorded from the coast of Chili in the South Pacific. There are two species which have been found in the Mediterranean and Atlantic, besides *L. glauca.*

L. amia, D. $7/\frac{1}{21}$, A. $2/\frac{1}{21}$. The upper maxilla reaches to at least as far as to below the hind edge of the eye: lateral-line with a semi-circular curve above the pectoral fin. Mediterranean and Atlantic Ocean in the Eastern Hemisphere.

L. vadigo, D. $7/\frac{1}{29\text{-}32}$, A. $2/\frac{1}{23\text{-}24}$. The upper maxilla reaches to below the hind edge of the eye: lateral-line slightly bent above the pectoral fin. Mediterranean and also Madeira.

1. **Lichia glauca**, Plate XLVII, fig. 1.

Prima glauci species, Rondel. viii, c. 16, p. 252, c. fig.; Willughby, p. 297. *Glaucus*, Gesner, 1598, f. 61, c. fig. *Lampuge*, Belon. p. 155. *Scomber*, No. 5, Artedi, Genera, p. 52.

Scomber glaucus, Linn. Syst. Nat. i, p. 494; Gmel. Linn. p. 1332; Bl. Schn. p. 33; Shaw, Zool. iv, p. 593.

Gasterosteus glaucus (Forst.), Bl. Schn. p. 539; Forst. Descrip. Anim. Cur. Lichtenst. p. 5.

Caranx glaucus, Lacép. iii, pp. 58, 66.

Scomber ascensionis, Shaw, Gen. Zool. iv, p. 593.

Centronotus glaucos, Risso, Ich. Nice, p. 194.

Centronotus binotatus, Rafin. Caratt. p. 43, t. viii, f. 2.

Lichia glaucus (or *glauca*), Risso, Eur. Mérid. iii, p. 429; Cuv. and Val. viii, p. 358, pl. ccxxxiv; Val. in Webb. and Berth. Iles Canar. p. 56, pl. xiii, f. 1; Jenyns, Manual, p. 366; Yarrell, Brit. Fish. (Ed. 3) ii, p. 232, c. fig.; Guichen. Explor. Algér. p. 61; White, Catal. p. 34; Günther, Catal. ii, p. 477; Canestr. Faun. Ital. p. 110; J. Couch, Zool. 1859, xvii, p. 6333; Steind. Ich. Span. u. Port. 1868, p. 41; Giglioli, Catal. Pesc. Ital. 1880, p. 28; Moreau, Poiss. France, ii, p. 454, c. fig.

Albicore, Couch, Trans. Linn. Soc. xiv, p. 82.

Derbio, Couch, Fish. Brit. Isles, ii, p. 139, pl. xcv.

B. viii, D. 5-6 | $\frac{1}{24\text{-}27}$, P. 17, V. 1/5, A. $2/\frac{1}{23\text{-}25}$, C. 17, Cœc. pyl. 13-16. Vert. 10/14.

Length of head $4\frac{2}{3}$ to 5, of caudal fin 4 to $4\frac{1}{3}$, height of body $3\frac{3}{4}$ to 4 in the total length. *Eye*—diameter $3\frac{3}{4}$ to 4 in the length of the head, 1 diameter from the end of the snout, and $1\frac{1}{2}$ apart. Lower jaw slightly the longer: the maxilla

reaches posteriorly to beneath the front edge of the eye. *Teeth*—in the jaws, vomer, palatine bones, and on the tongue. *Fins*—spines of first dorsal fin of about equal length: anterior portion of second dorsal somewhat elevated: while the anal is slightly shorter than but otherwise similar to the second dorsal. Pectoral as long as the head behind the middle of the orbit: ventral shorter: free anal spines rather strong. Caudal fin deeply forked. Free portion of the tail about as high anteriorly as it is long. *Scales*—small: cycloid. *Lateral-line*—makes a very slight curve to above the commencement of the anal fin, when it proceeds direct to the centre of the base of the caudal fin. *Colours*—very bright, superiorly gray or greenish, becoming lighter or yellow on the sides and beneath. Three or four gray blotches, sometimes absent, across the anterior portion of the lateral-line. Fins yellowish, the anterior rays of the second dorsal and anal, also the ends of the caudal lobes, stained with black.

Names.—*Glaucus* from its light sea-green colour. This fish has also erroneously been termed *albacore* by Couch, that being the designation of a tunny (see p. 98). According to Rondeletius, *Derbio* is a local term employed at Montpellier.

Breeding.—Risso observes that in the Mediterranean it breeds during the summer.

As food.—Was esteemed in Greece and Rome.

Habitat.—Common throughout the Mediterranean and in the Atlantic from the southern shores of Great Britain southwards along the west coast of Africa to the Cape of Good Hope, as well as across the South Atlantic Ocean to the coast of Brazil.

In October, 1857, Couch obtained an example, 13½ inches in length, from a drift net, which had been employed in the autumn mackerel fishery, in deep water off the Runnel Stone, Mount's Bay, Cornwall. On August 28th, 1878, a second example was captured near Penzance (Cornish, Zool. 1878, p. 423).

This fish appears to attain to at least 15 inches in length.

Genus V.—Capros, *Lacépède.*

Branchiostegals five: pseudobranchiæ well developed. Body elevated and compressed. Mouth very protractile. Small teeth in the jaws and vomer, but absent from the palatine bones and tongue. Two dorsal fins placed close together, the first, with nine strong spines: the second many rayed (23-25): *anal with three spines, and the rays similar to those of the second dorsal. Ventral with one spine and five rays. Scales small and very rough: a scaly, but no bony, ridge along the bases of the soft dorsal and anal fins. Air-bladder large. Pyloric appendages few.*

Lowe instituted in 1843 Family Caproidæ for the reception of this genus, and the allied one of *Antigonia*, Lowe, which latter is identical with *Caprophonus*, Müller and Troschel, and has been obtained from Madeira as well as Barbadoes. *Hypsinotus rubescens*, Tem. and Schlegel, Fauna Japonica, plate xlii, f. 2, appears very similar to, if not identical with, *Capros*, but having a smaller eye than the European species; should this be the case, it is another instance of fishes extending from European into Japanese waters. The *Capros* is not very distantly allied to the Dorees, *Zeus*.

Geographical distribution.—From the shores of the British Isles to Madeira, also through the Mediterranean.

1. Capros aper, Plate XLVII, fig. 2.

Aper, Rondel. v, c. 27, p. 161, c. fig.; Aldrov. iii, c. 12, p. 297; Jonston, i, tit. i, c. 1, Art. 4, t. i, f. 8; Willughby, p. 296, t. I 4, fig. 4; Ray, p. 99; Artedi, Genera, p. 50; Gesner, 1598, f. 30, c. fig.

Zeus aper, Linn. Syst. Nat. i, p. 455; Gmel. Linn. p. 1225; Bl. Schn. p. 96; Bonnaterre, Ency. Ich. p. 73; Jenyns, Manual, p. 368.

Perca pusilla, Brünn. Ich. Mass. p 62; Gmel. Linn. p. 1311; Bl. Schn. p. 88; Shaw, Zool. iv, p. 550.

Perca brunnich, Lacép. ix, p. 412.

Capros aper, Lacép. iv, p. 591; Risso, Ich. Nice, p. 305, Eur. Mérid. iii, p. 380; Boase, Pro. Zool. Soc. 1833, p. 114; Harvey, P. Z. S. 1836, p. 54; Yarrell, Brit. Fishes (Ed. 1) i, p. 169, c. fig. (Ed. 2), i, p. 190 (Ed. 3), ii, p. 258; Swainson, Fishes, ii, p. 252; Kidd, Zoologist, 1843, p. 91, c. fig.; Cuv. and Val. x. p. 30, pl. cclxxxi; Guichen. Explor. Algér. Sc. Poiss. p. 65; Cuv. Règne Anim. Ill. Poiss. pl. lx, f. 2; Lowe, Trans. Zool. Soc. ii, p. 183; Andrews, Nat. Hist. Rev. 1858, p. 188; Gray, Ann. and Mag. Nat. Hist. (3), 1866, xvii, p. 237; White, Catal. Brit. Fish, p. 41; Günther, Catal. ii, p. 495; Canest. Faun. Ital. p. 111; Giglioli, Catal. Pesc. Ital. p. 28; Steindachner, Ich. Span. u. Port. 1868, p. 45; Moreau, Poiss. France, ii, p. 475, c. fig.

Zeus Childrenii, Bowd. Excur. Madeira, p. 124.

Boar-fish, Couch, Fish. Brit. Isles, ii, p. 142, pl. xcvi.

B. v, D. 9/23-25, P. 13, V. 1/5, A. 3/23-24, Cœc. pyl. 2-3. Vert. 10/12-13.

Length of head $3\frac{1}{4}$ to $3\frac{1}{3}$, of caudal fin $4\frac{2}{3}$ to 5, height of body $2\frac{1}{3}$ to $2\frac{1}{2}$ in the total length. *Eye*—In the upper half of the depth of the head, diameter $2\frac{1}{2}$ to $2\frac{3}{4}$ in the length of the head, 4/5 to 1 diameter from the end of the snout, and 2/3 to 3/4 of a diameter apart. Body strongly compressed, both the upper and lower profiles of the snout concave. The bones of the head roughened, the posterior limb of the premaxillaries extends backwards to opposite the middle of the eyes. Jaws equal in length anteriorly, the posterior extremity of the maxilla does not extend so far as to beneath the front edge of the eye. Preopercle serrated in its whole extent, likewise, but not so coarsely, the suborbital ring. Posterior nostril oval and much larger than the anterior, which is nearly circular. *Teeth*—minute in the jaws and on the vomer, none on the palatines or on the tongue. *Fins*—spines of first dorsal strong, the third and fourth the longest, twice as high as the longest rays, and equalling about half the height of the body below

them: rays of the second dorsal low, those in the last portion of the fin highest. Ventral spine strong, its outer edge and also those of the rays being exceedingly rough, the fin is inserted beneath the base of the pectoral, which latter is about half the length of the head. Anal spines weak. Caudal rounded. *Scales*—small, very rough, having small spinate points directed posteriorly, those on the head with less distinct spinate elevations: this makes the body feel quite rough when the hand is passed from behind forwards, which sensation is not experienced when stroking the fish from the head towards the tail. A roughened ridge along the bases of the second dorsal and anal fins. *Lateral-line*—ascending from opposite the eye to nearly the base of the first dorsal fin, when it bends downwards, forming a semi-circle, being lost below the base of the second dorsal. *Cœcal appendages*—three rather large ones in all I have examined. *Colours*—of an orange-red, with a rather darker band over the base of the tail, while the outer edge of the ventral is darker than the remainder of the fin. In one example the body had numerous narrow white vertical bands: in another, a row of small black spots along the base of the dorsal fin. Some which were placed in a darkish tank in an Aquarium, June 18th, 1880, became as follows on July 12th:—They all seemed in good health, were lively, but strangely altered in colour. They may be described as of a straw colour, with broad dark vertical bands of a deep brown hue. The first passed over the head: the second from the first dorsal fin down to the outer third of the ventral: the third from the second dorsal curved downwards and rather backwards to the anal fin: while the fourth band was over the free portion of the tail, the outer edge of which fin was white. Looking from above down upon these fish the bands were seen to meet on the back, while after death they almost entirely disappeared. On August 13th, two still survived, but the water was rather clearer, while the weather had been brighter, and the intensity of the dark bands had decreased, while the red was a little more apparent. Mr. Dunn tells me that after spawning he observed the bands decrease in intensity. Yarrell mentions an example with seven transverse orange coloured bands; he also refers to a specimen belonging to Mr. Thompson, which had a bright silvery patch with a scarlet border in the middle of its side.

Names.—From the shape of its snout, which is capable of being greatly protruded, it has obtained the designation of *boar-fish*, it is also said to grunt, but this appears doubtful, however, it has been stated to emit an odour the reverse of agreeable, but which I could not discover. At Plymouth it is sometimes known as *cuckoo-fish* and *cook-wrasse*. At Lossiemouth it has been termed *sun-fish*. *Le capros sanglier*, French.

Habits.—These are but little known, but it appears to prefer moderately deep water in the vicinity of rocks. Along sandy coasts they are frequently cast up dying or dead, especially after strong gales of wind, or else left on the shore as the tide recedes, and have sometimes been found entangled in seaweed. In an aquarium they do not try to conceal themselves, and Mr. Dunn found that they readily consumed pieces of pilchards. Small crustaceans, also molluscs, have been found in their stomachs. Wounds from their spines are somewhat dreaded by fishermen as being rather poisonous or perhaps very irritant.

Breeding.—July 20th, 1880, Mr. Dunn observed that many of these fish had spawned in his tank; the spawn all floated in the water just below the surface, and seemed to be of the same specific gravity as the sea water. The tank being beneath the surface it all floated away. Some taken in March, 1879, off Dorsetshire, were found to contain spawn. Mr. Baker took one full of spawn in the Bristol Channel, in May, 1850. Risso observed that in the Mediterranean it deposited its spawn in April.

As food.—They cannot be of any importance, having so little to eat upon them, but Mr. Penney, who had some fried, reported them as delicious, their flesh possessing a creamy whiteness and a delicate flavour (Land and Water, April 5th, 1879). Mr. Couch, who tasted some, did not recommend them, neither did Risso.

Habitat.—Mediterranean during the spring and autumn, but are not

abundant: they seem to be more common in the Gulf of Lyons. Locally abundant off the south coast of Britain, they extend to Madeira, from whence Lowe sent specimens to Yarrell.

The first capture recorded in the British Isles was in Mount's Bay, October, 1825: then solitary examples at Bridgewater in 1833: in 1836 one was taken on the south coast of Devonshire, and one at Teignmouth about the same time: at Lossiemouth in 1839, when the specimen, 7 inches long, was sent to the Elgin Museum. On March 6th, 1842, another was found alive on the beach at Brighton, and considered such a rare acquisition that it was sent for Her Majesty's acceptance, when H.R.H. the Prince Consort was the first who recognized and correctly identified the fish as the *Capros aper*.

One was taken at Falmouth in 1841, while on August 12th, 1843, the shore on the western side of Plymouth was strewn with numbers captured by trawlers, who threw them overboard when turning out their nets. A strong easterly wind is said to have been blowing, and which was surmised to have driven them inshore. Mr. Gatcombe, in the Zoologist, p. 429, observed:—"I should say there were more than a thousand of them, and almost all of the most beautiful colours, some quite crimson, others more scarlet or pink, but all more or less beautifully banded or striped. I found, however, that these bands soon faded or disappeared altogether on being exposed to the light and air." The fishermen stated that within a few years these fish have swarmed to such an extent as to have become a perfect pest, and that in many instances the trawlers have actually been obliged to change their fishing ground in order to be out of their way. Such immense numbers often got into the trawl that holes had to be cut in the net to allow the fish to escape, as it was found almost impossible to lift such a great bulk on board without carrying away their gear.

In July, 1844, about two hundred were taken in a trawl (the first that had been tried) off the Runnel Stone, and others continued to be captured for three months in the neighbourhood and along the coast near Land's End, a tract not much visited by the Mount's Bay fishing boats (Holme, Zool. p. 769). In 1845 more were taken in the same locality: one at Falmouth in June, 1846: another at Bridgewater in May, 1850, which proved to be full of spawn, and in 1852 one in the Moray Firth (Gordon, Zool. p. 3459), and many other solitary instances were subsequently recorded. 1866 one from Devonshire. In March, 1868, an immature example was washed ashore in White Sands Bay, Land's End, having a well-defined black spot at the upper part of the base of the caudal fin, and another was captured the same month (Cornish, Zool. p. 1222).

Since then I find the following instances recorded in the Zoologist. One from the Scilly Isles in 1870, where the fishermen declared they had not previously seen it: in June, 1873, one was taken at Hastings, 5 inches long: one from Torcross in 1875, and another in September from Poole: a shoal of fifteen taken on the south-west coast of Cornwall, and exhibited in the Crystal Palace Aquarium. July 4th, 1877, one in the Isle of Wight. During May, 1879, numbers were cast ashore in a sickly state at Bournemouth: others were taken at Rye and Hastings, while four were washed ashore on the Dorsetshire coast on the sand banks at Poole during the night of March 30th, some of them contained spawn. April the same year two were recorded from Exmouth: two from Torquay in February: in May one was picked up on the beach at Eastbourne; and another brought alive into Grimsby from the mouth of the Humber.

Mr. Dunn, of Mevagissey, in his very interesting remarks upon the fishes of that locality, written in October, 1878, observed:—"Common here from the Start to the Lizard: these past five years they seem to be on the increase, thousands are yearly caught by Plymouth trawlers off Deadman Headland, and thousands more are brought to land by our drift fishermen. In June and July last year I had over 150 alive in my tanks at one time."

In 1879 Mr. Gunn recorded one picked up alive, May 16th, near Eastbourne, and Mr. Carrington reported the capture of other examples from various parts of the south and south-east coast of England during the month of June. The localities

given are Weymouth, Bournemouth, Sheerness, Harwich, and Southend-on-Sea. June 18th, 1880, about sixteen were brought alive to the Westminster Aquarium. I first saw them being transferred to a tank of still water. The most lively used their fins like other fishes, but as they got worse the dorsal commenced working at a great rate, though not so rapidly as in *Zeus faber.* They sank down and died, the head being kept highest, but some turned over on to their backs. This fish has also been captured in Scotland, as already observed. Edward also informs us of another example having been taken near Covie, in Banffshire, in August, 1862; while in Ireland Andrews obtained it in a trawl in 1867, off Ventry Harbour.

This fish, the appearance of which in Britain was first noticed in 1825, is now in abundance in limited tracts, and taken from March until October. It is remarkable, in that it may be banded or plain, the bands, it having been suggested, being due to the example having been in a dark locality.

Attains to 7 inches in length.

Family, XIII—CYTTIDÆ, *Kaup.*

Branchiostegals seven or eight: pseudobranchiæ present. Body elevated and compressed. Gill-openings wide: eyes lateral. The infraorbital bones do not articulate with the preopercle. Minute teeth in the jaws and vomer, present or absent from the palatine bones. Two dorsal fins placed close together, the first spinous: ventrals thoracic. Scales, when present, small: or osseous bucklers may exist. No anal papilla. Air-bladder present (in *Zeus*). Pyloric appendages numerous. Vertebræ exceed 10 abdominal and 14 caudal.

Geographical distribution.—These fishes are found in the temperate and semi-tropical seas of both hemispheres.

Genus I.—Zeus, *Cuvier.*

Branchiostegals seven: pseudobranchiæ present. Body elevated and strongly compressed. Mouth very protractile, its cleft deep. Occipital crest high. Small teeth on the jaws and vomer, but absent from the palatine bones. Two dorsal fins placed close together, the first with nine to ten spines, and the length of its base about equal to that of the second dorsal. A row of bony plates, often armed with spines, along the sides of the bases of the dorsal and anal fins: also a row of bony plates, usually armed with spines, on the ventral surface from the throat to the ventral fin. Scales, when present, small. Air-bladder large. Pyloric appendages numerous.

These fishes have been considered by some Ichthyologists as constituting a distinct Family—Zeidæ. Gill has separated from *Zeus* those forms which more exclusively inhabit deep water, constituting them into a genus termed *Zynopsis.*

As already observed, many fishes undergo remarkable modifications during their gradual change from youth to age, and Agassiz (Am. Sc. Nat. 1865, iii, p. 56) considered *Argyropelecus hemigymnus*, Cocco, to be the young of *Zeus faber.* This Kner (Verh. z. b. Ges. Wien, 1865, p. 288) showed to be incorrect, as the gill-rakers of the last are long, but very short in *Zeus*, whether old or young.

Geographical distribution.—From Scandinavia to the British Isles and through the Mediterranean: also along the eastern portion of the Atlantic Ocean to the Cape of Good Hope: as well as Japanese and Australian seas.

1. Zeus faber, Plate XLVIII.

Zeus s. Faber, Pliny, ix, c. 18, xxxii, c. 11. *Faber*, Ovid, Hal. v, 110; Colum. viii, c. 16; Wotton, viii, c. 181, fol. 160 *b*; Salv. p. 203; Aldrov. i, c. 25, p. 112; Jonston, lib. i, tit. 2, c. 1, Art. 18, t. xviii, f. 1, 2; Ray, p. 99. *Faber sive gallus marinus*, Rondel. xi, c. 19, p. 328; Rutty, i. p. 366; Gesner, pp. 369, 439; Willughby, p. 294, t. S. 16; Artedi, Gen. p. 50; Gronov. Zooph. p. 96, No. 311 and Mus. Ich. i, p. 47. *Poule de mer*, Duhamel, Pêches, ii, Sect. v, p. 86. *Doree*, Pennant, Brit. Zool. (Ed. 1) iii, p. 221, pl. xli (Ed. 2), iii, p. 296, pl. xlv; Brunn. Pisc. Massil. p. 33.

Zeus spinosus, Linn. Mus. Ad. Fr. 1754, p. 67, t. 31, f. 2.

Zeus faber, Linn. Syst. i, p. 454; Bloch, Fisch. Deutsch. iii, p. 24, t. xli; Gmel. Linn. p. 1223; Lacép. iv, p. 577; Bl. Sch. p. 94; Donovan, i, pl. viii; Shaw, Zool. iv, p. 285, pl. 41; Turton, p. 95; Risso, Ich. Nice, p. 303, and Eur. Mérid. iii, p. 379; Fleming, Brit. An. p. 218; Martens, Reise Nach Venedig, ii, p. 435; Cuv. and Val. x, p. 6; Cuv. Règne Anim. Ill. Poiss. pl. lx, f. 1; Yarrell, Brit. Fishes (Ed. 1), i, p. 162, c. fig. (Ed. 2), i, p. 183 (Ed. 3), ii, p. 251; Templeton,

Mag. Nat. Hist. (2) 1837, i, p. 409; Johnston, Berwick. N. H. F. Club, 1838, i, p. 171; Parnell, Fishes Firth of Forth, p. 60, and Wern. Mem. vii, p. 220; Jenyns, p. 367; Swainson, Fishes, ii, p. 252; Gronov. ed. Gray, p. 128; Thompson, N. Hist. Ireland, iv, p. 96; Lowe, Trans. Zool. Soc. ii, p. 183; Val. in Webb and Berth. Iles Canar. Poiss. p. 59; Guichen. Explor. Sc. Algér. Poiss. p. 64; White, Catal. Brit. Fish. p. 38; Günther, Catal. ii, p. 393; Schlegel, De Dieren Neder. p. 15, pl. ii, f. 1; Collett, Norges Fiske, p. 44; McIntosh, Fish. St. Andrew's, p. 173; Steind. Ich. Span. u. Port. 1868, p. 14; Giglioli, Catal. Pesc. Ital. p. 26; Lütken, Spol. Atlan. p. 198; Moreau, Poiss. France, ii, p. 467.

Zeus pungio, Cuv. and Val. x, p. 25, pl. cclxxx; Guichen. l. c. p. 64; Günther, Catal. ii, p 394; Steind. l. c. p. 16, t. vi; Moreau, l. c. p. 427, c. fig. (*species with long supra-scapula spine.*)

Doree, Couch, Fish. Brit. Isles, ii, p. 118, pl. lxxxix.

B. vii, D. 10/22-23, P. 13, V. 1/6, A. $\frac{4}{21-23}$, C. 13, Vert. 14/18.

Length of head $2\frac{3}{4}$ to 3, of caudal fin $4\frac{1}{2}$, height of body $2\frac{1}{4}$ in the total length. The greatest thickness of the body equals 1/5 of its height. *Eye*—high up, one diameter in the postorbital length of the head. Head as high as long. Mouth very protractile, its cleft oblique, the maxilla being nearly perpendicular when it is closed, and not reaching backwards to beneath the eye: lower jaw the longer and terminating posteriorly in two spines. Opercles spineless. Scapular region ridged in the adult, and having some spines in the young: some also at occiput. *Teeth*—finely cardiform, present on the jaws and vomer, but not on the tongue or palatine bones. Gill-rakers few, short, and finely spinate, *Fins*—first dorsal almost continuous with the soft portion, its spines rather strong, gradually increasing in length to the fourth, the interspinous membrane is externally prolonged into filaments of varying lengths: while at the base of each spine is an outwardly projecting spinous process. Second dorsal increasing in length to its third quarter, and armed along its base with from seven to ten spines situated on a bony plate, each of which consists of two portions: the largest, curved and broad, is directed somewhat backwards, while the shorter portion is produced outwards and a little forwards: its rays unbranched (in *Z. Australis*, Richardson, "the last rays of the dorsal and anal are divided to their base"). Pectoral short. Ventral as long as the head, and having (in the young) a spinate base: a double ridge extends from this fin to the vent, armed with eight lateral spines on either side. The anal spines and rays are similarly armed to those of the dorsal fin. Second anal spine the longest and somewhat the strongest. Caudal rounded. *Scales*—not imbricate, a few along the cheeks. *Lateral-line*—descends in a gentle curve from opposite the upper edge of the eye to above the middle of the anal fin, from whence it proceeds direct to the centre of the base of the tail. *Viscera*—stomach rather large, the narrow pyloric portion encircled by numerous cœcal appendages, which in some cases are branched. *Air-bladder*—elongated, with the appearance of a slight constriction in its posterior fourth, while a rounded muscular body exists in its anterior fourth, from which passes a tendon. On opening the air-bladder, its lining membrane is found to cease at the commencement of the last fourth of the organ, and here it forms a very low valve. In the interior of the upper half of the air-bladder is a narrow, vermiform, red gland, of a semi-circular form. *Colours*—olive gray, with a yellowish tinge, and usually yellow wavy horizontal bands. In the middle of either side, just posterior to the pectoral fin, a circular or oval black spot surrounded by a narrow yellow ring. Fins gray, in some examples the ventrals are nearly black: in others, two rather dark horizontal bands pass along both the dorsal and anal fins.

Varieties.—Zeus pungio, C. V. has a shoulder spine as long or longer than the diameter of the eye, while in *Z. faber* it is hardly visible in adults, and certainly these differences cannot be referred to the age or the sex of the fish. Occasionally the lateral blotch is absent. This form appears confined to the Mediterranean.

Zeus Japonicus, Cuv. and Val. x, p. 24; Bleeker, Verh. Bat. Gen. xxvi, Japan, p. 105; Günther, Catal. ii, p. 394, and *Z. faber Japonicus*, Schlegel, Fauna Japon.

p. 123, pl. 66A, appear to differ from *Zeus Australis*, Richardson, Voyage Erebus and Terror, pp. 36, 138, pl. xxv, fig. 1 (and which Dr. Günther has united with *Zeus faber*), in that *Z. Japonicus* has only six or seven bony plates along the bases of the soft dorsal and anal fins, while *Z. Capensis* has eleven in the same situation.

A stuffed specimen of *Zeus Capensis*, Cuv. and Val., or the Cape species of this genus, about 24 inches in length, exists in the British Museum, the length of the head of which is 1/3 of that of the total. If identical with *Zeus faber*, the double row of lateral spinous plates along the base of the second dorsal have lost one process: the abdominal spines have likewise become plates.

Names.—The Greek name *Zeus* appertained also to Jupiter: while the latin term *Faber* was given it due to the fancied resemblance many of its bones had to tools used by mechanics. The common term, *dory* or *doree* or *John dory*, is probably merely a corruption of *Jaune dorée*, or "golden-yellow," which has reference to its colour. Superstition, regardless of its absence from the Lake of Gennesaret, has attributed the marks upon its sides to the effects of St. Peter's finger and thumb when he captured a fish in order to obtain the tribute money. This fish was formerly suspended in churches and the legend of the mark duly detailed and implicitly believed. Some even averred that the spots were elegant representations of the coin which was found. Others, however, thought that as this fish does not exist in the waters where this miracle was performed it is unlikely that to it belongs the honour attributed. Another derivation for "John doree" is the name *janitore*, by which it is known in Venice: a name likewise applied to St. Peter, the keeper of the keys; in short, the doorkeeper of a better world. Again, the haddock has been pointed out as possessing two black spots of a similar character, irrespective of which, as in the East, numerous fresh water and a few marine species are thus marked, it seems a rather bold assumption to advocate that this form must be a descendant of the identical species referred to. St. Christopher is also credited with having captured this fish, and left a record on its sides, as shown by the marks on the dory. Sir T. Browne, in his list of Norfolk Fishes, 1662, observed "the *Faber maximus* sometimes found very large . . . we often meet with in these seas, sometimes called a *peter-fish*." Merrett, in his *Pinax Rerum Naturalium Britannicarum*, published in 1666, speaks of this fish as *Dorée*. Another, but more far-fetched, derivation of the origin of the term "*John Dory*" has been advanced, and is that it is a corruption of the Gascon term *Jan*, or a "cock," and that consequently it means "gilt cock," and as a further evidence, the circumstance that this fish in southern Europe is termed *gallo*, or "cock," from the crest on its nape. Alston (Zool. 1866, p. 435) observed that in Arran one was called *golden haddock*. *Sion dori*, Welsh. *De zonnevisch*, Dutch. *Le zée*, French.

Habits.—This fish is somewhat sluggish, and said to be frequently carried along by currents, while in swimming it is usually seen somewhat on one side, which enables it to rest against a rock as well as to see both above and below it. Although its movements are generally slow they become accelerated when it desires food, which it pursues by a sort of succession of jerks. Couch suggested that the filamentous prolongations from its fins are used as decoys, and that it buries itself or lies on the sand, where it waves them as the *Lophius* does its tentacles. It is a great wanderer, and in the winter many appear to retire to deep water, returning in the spring in excellent condition. It seems to prefer during the warm months rough ground to deep water, as well as sandy bays where weeds and small fishes abound. It has been said to grunt or groan when being removed from the water. A member of the present Fishery Department informed me that he distinctly heard some just captured emit a squeaking sound. It has a very voracious appetite. At the Westminster Aquarium this fish will eat "sand smelts," and has been known when hungry to swallow a young "bass." One which weighed 1 lb. 1 oz. was found to contain eighteen sprats, two sand smelts, and one cuttle fish, besides a number of small fish in a decomposed state. From another, 12½ inches in length, Couch took twenty-five "flounders," some of which were 2½ inches in length: three half-grown "father lashers" and

five stones from the beach. It, however, was so gorged that it permitted itself to be taken by the hand.

Mr. Savile Kent has drawn particular attention to the manner in which this fish uses its fins, the movements of which he, with great justice, likens to that of the dorsal fin in the pipe-fish. This rapid motion affects the soft rays and inter-radial membrane of the dorsal, anal, and pectoral fins: all, or merely some of which, may be in motion at the same time. This may be perceived both when they are ascending in the water, descending, or even when reclining over on one side: but they are likewise able to move their fins more slowly as generally seen in fishes.

Many cases of *whitlow*, involving the loss of joints of fingers, are occasioned from injuries inflicted by the spines placed at the bases of the dorsal and anal fins in these fishes.

Means of capture and baits.—It is obtained most abundantly during summer and autumn, but some are captured throughout the year. It will take a spinning bait: a baby-spinner tagged with a small strip of prepared rays skin and a rod with fine tackle has been recorded as killing. The best bait is a small fish, especially a young sea-bream, *Pagellus*, hooked by the tail or back. This is swallowed head first, by which means the spines of the bream are said to act like a hook. It will also take pieces of mackerel, pilchard, or cuttle.

Breeding.—Very prolific, and minute young ones are common. Mr. Dunn thinks it spawns in winter: the young are 2 or 3 inches in length in August.

In the middle of last century a sudden advance in the price of these fish took place. Couch quotes a MSS. note as follows:—"Dorys yt used to be sold for three to four pence a piece are now two shillings or half-a-crown a good one." The same author remarks on upwards of sixty one autumn being hauled on shore in one ground seine, the entire lot of which realized nine shillings.

As food.—It is considered by some to be in the best condition for the table during the last four months of the year, but others recommend it as being of superior excellence from January to March: while fishmongers prefer them from the Devonshire coast. It was much prized by the Romans, who deemed it to be sacred to Neptune. John Quin, the actor, who died at Bath in 1766, when 73 years of age, is commonly reported to have added this delicacy to our tables, and some have even asserted that so pleased was he with it that it was commonly known as *John's dory*. Prior to his time prejudice has been said to have banished it from the repasts of the rich, owing to its hideous aspect. Rutty (1772) observed, respecting the County of Dublin, that "it is frequent and excellent food, preferred by some to the turbot, though scarce known here before the year 1729." Borlase, in Cornwall, 1755, remarked, "this fish is of firm substance and much coveted, but rather dry in comparison of the sole and turbot." Sir J. Banks placed it among "the most valuable of fishes, as it required no sauce." Some good judges of eating rank it next after the turbot.

Mode of cooking.—They are somewhat improved by not being cooked for two or three days after their capture: large ones should have their fins cut off, and look best if the head is removed. After having been well cleaned they are boiled very slowly, and Quin recommended that this should be done in sea-water: they may be served with lobster or shrimp sauce, or without any. Or the fish may be prepared similarly to turbot, or stewed. In Italy, equal parts of wine and water are employed when cooking these fish: while they are mostly eaten cold with a sauce of oil and lemon juice, and a sprinkling of salt and pepper (Badham). Small ones are best baked, having a few bits of butter on them to prevent their drying up when in the oven: they take about a quarter of an hour.

Habitat.—Has been taken as far north as Norway: seems to be absent from the Baltic, but extending southwards towards the British shores, where it increases in numbers: it is also found along the Atlantic coasts of Europe,

as well as throughout the Mediterranean. If the *Z. Capensis*, &c., are merely varieties, it extends to the Cape, also to the seas of Japan and South Australia.

In Great Britain it is common along the south and west coasts, becoming rarer proceeding towards the north. At Hartlepool Hogg recorded its occurrence in February, 1860, observing that it had not been taken there previously. Paget mentions its capture at Yarmouth, and Johnston off Berwickshire.

Parnell informs us that in the Firth of Forth seldom more than one or two are captured during the course of a year: it is rather rare at St. Andrew's (McIntosh), but not uncommon as a summer visitor in Banffshire, where it is mostly taken in the salmon nets (Edward): while two were obtained off Elginshire (Gordon, Zoologist, 1852, p. 3459). It does not appear to be included among the fishes of the Orkneys.

In Ireland it is found all round the coast, but sparingly in some localities. Thompson says that their numbers increase northwards, and he was credibly informed that about twenty are taken in the vicinity of Portrush for one in Belfast Bay.

In August, 1879, one at Norwich, which weighed 14 lb., was recorded in "Land and Water." Couch mentions another, 22½ inches in length, which scaled 18 lb.

Third group—Xiphiiformes.

The snout and upper jaw is produced into a long sword-shaped weapon.

Family, XIV—XIPHIIDÆ, *Agassiz.*

The sword-fishes.

Branchiostegals seven: pseudobranchiæ present. Eyes lateral. Body compressed, the upper jaw (comprising ethmoid, vomer, and pre-maxillaries) produced into a long sword-shaped process: cleft of mouth deep. Teeth, when present, rudimentary. Scales absent or in the form of rudimentary dermal productions. Air-bladder present. Pyloric appendages numerous, when present.

These fishes are divisible into two distinct genera, *Xiphias*, destitute of ventral fins and having a somewhat flattened snout: and the more tropical *Histiophorus*, which possesses ventral fins, while its snout is more or less of a triangular shape.

The fry of these fishes are likewise capable of being discriminated. The young in *Xiphias* has its jaws elongated, the two being of nearly equal length: also the supraorbital region as well as the angle of the preopercle spinate, while the forehead has not the abrupt depression that exists in *Histiophorus*. This latter has large spines at the occiput and angle of the preopercle. Davy observes that the specific gravity of the blood of the sword-fish he found to be 1·051 taken from a large one caught in the Bosphorous during the month of December.

In the European seas and extending into those of the tropics there exist the sword-fishes (Xiphiidæ), which are well known to attack whales, and occasionally vessels, which they would appear to mistake for their gigantic opponents, and some authors have even believed that they will vent their spleen upon rocks, perhaps mistaking such for the sides of their hereditary antagonists. These fishes attain to a very large size, as 15 feet or (some assert) 20 feet or more in length. There may be two ways in which the foundering of a ship is occasioned when pierced by these creatures—either a leak may be at once set up, or else the perforating snout may act as a plug, not permitting leakage until decomposition has set in or the salt water has softened the bones.

In 1874 the "Cashmere," a new steamer, of about 1400 tons burden, was nearly lost, owing to an injury inflicted by a sword-fish. The vessel was on her course from Bombay to Calcutta, when, without any apparent cause, she began to make water, while all attempts to discover the cause of the leak were futile, until, after the removal of a large part of the cargo, the lightened ship rose in the water, and a piece of the snout of a sword-fish was observed. This had pierced the copper and timber of the ship and penetrated some 9 or 10 inches beyond, breaking off close to the copper, probably from the impossibility of withdrawing it. The sword had not merely pierced the ship, but split the plank for a considerable distance on each side of the point of contact. In this instance there could have been no doubt that a leak had occurred, while an examination of the ship demonstrated that it had been entirely due to the injury inflicted by one of these fishes.

The ship "Royal George," of about 500 tons burden, experienced a dreadful hurricane in the Bay of Bengal. So furious was the tempest, that, in addition to the loss of the main and mizen masts, the bowsprit was found broken off close to the hull of the vessel. Its diameter was 23 inches, and, on examining its base, the snout of a sword-fish was found projecting about 6 inches beyond the surface. A similar occurrence took place in 1833, and the perforated planks, with the imbedded sword, were presented to the Asiatic Society of Bengal, and are now in the Calcutta Museum.

The British Museum possesses a specimen of planks from a ship's side, in which may be seen the sword of one of these fishes, which has penetrated 22 inches into the timber. In the museum of the Royal College of Surgeons is the

section of the bow of a South Sea whaler, which has been penetrated through 13½ inches of solid timber by the snout of a swordfish, which latter is 12 inches long and 5 inches in circumference. When H.M.S. "Leopard" was repaired in 1725, after her return from the coast of Guinea, it was found that a swordfish had pierced her outer sheathing, 1 inch in thickness, next a 3-inch plank, and finally 4½ inches further into a solid beam.

The foregoing facts seem to be sufficient to demonstrate that in numerous instances swordfishes have attacked vessels and occasioned leaks. The reason why they should act thus leads us to inquire what can be the common use of such a weapon to a fish which merely possesses small teeth in its jaws? The ancients asserted that it transfixes fish with its snout for the purpose of obtaining food—a process which has been compared by one writer to skewering larks—but without being able to obtain its prey. We have likewise been informed that the proper use of this sword-like projection is to turn up the sand, &c., to hunt for minute sea creatures on which it lives. If this long process is intended simply for digging up sand, it seems curious why it should have been so rigid, for a softer, wider, and more tactile organ, such as exists in the snout of the sturgeon, would be better suited for such a purpose. I would suggest—first, that the rostrum is not intended for turning up the sand: secondly, that it is intended entirely for offensive purposes, or to obtain food: and lastly, that these fish do not solely live upon "minute sea creatures," although, doubtless, they occasionally devour cuttles, sepia, &c.

Cuvier informs us that the European form (*Xiphias*) which he examined contained the remains of fish. I was on the Madras beach on the evening of February 15th, 1867, when I saw a swordfish, *Histiophorus gladius*, 9 feet in length, being carried by two fishermen towards their huts; for, although this fish is unmarketable, their families consume it. Its long back fin was of a bright Prussian blue, covered with large dark spots; hence its native name Myl-meen, or "peacock-fish." I purchased the example, and found inside it a full-sized Indian mackerel (*Scomber microlepidotus*), two large half-beaks (*Hemiramphi*), and numerous small fish. Still, eating merely small forms would scarcely seem to account for the necessity of its being provided with an elongated, sword-like snout, which, added to the great rapidity of its movements, would render it a truly formidable opponent. Belonius tells us that shoals of tunnies (*Orcynus thynnus*), in the Mediterranean, are as much alarmed at the presence of a swordfish as a flock of sheep are at the sight of a wolf. It pursues them with great pertinacity, and transfixes them with its snout: but recent authors have not remarked on its doing such to obtain food. In Daniel's "Rural Sports" we read that "in the Severn, near Worcester, a man bathing was struck, and absolutely received his death wound from a swordfish. The fish was caught immediately afterwards, so that the fact was ascertained beyond a doubt."

It was thus evident that the swordfish eats other fish; that it can kill them by transfixion: and it has been known to vent its strength upon a human being. A step further takes us to the fact that it will attack even whales, and, as it eats flesh, we may perhaps conclude that hunger induces them to do so for the purpose of obtaining food. Capt. Crow, on a voyage to Memel, tells us that one morning during a calm, when near the Hebrides, all hands were called up at 3 a.m. to witness a battle between several of the fish termed thrashers or fox sharks (*Alopecias vulpes*) and some swordfish, on the one side, and an enormous whale on the other. As soon as the whale's back appeared above the water the thrashers, springing several yards into the air, descended with great violence upon the object of their rancour, and inflicted upon him the most severe blows with their long tails, the sounds of which resembled the reports of muskets fired at a distance. The swordfish in turn attacked the distressed whale, stabbing from below; and, thus beset on all sides and wounded, the water around him was dyed with blood. Couch was of opinion that as the swordfish has no teeth to tear the flesh, and he supposed it could only swallow its food whole, it must have been gratifying its appetite with blood. At a meeting of the Linnean Society in 1881, Mr. Howard Saunders observed that he had personally

witnessed a fight between a whale and a fish, which was stated to be a thrasher shark* assisted by a swordfish. He distinctly saw its elongated sword-like snout glancing in the light after it had made a plunge at the whale and missed its mark.

Dr. Jerome Smith, in his History of the Fishes of Massachusetts, states that on a calm sunny day during the previous summer (1832), as a pilot was leisurely rowing his little skiff, he was suddenly roused from his seat by the plunge of a swordfish, thrusting its long spear, more than 3 feet through the bottom of his slender bark; but the pilot broke it off with the butt of his oar before the submarine assassin had time to withdraw it. Irrespective of using this organ to obtain food, it is evidently occasionally employed when fighting with its enemies.

Lastly, I may advert to the case of the ship "Dreadnought," which in 1868, while on her voyage from Ceylon to London, suddenly sprung a leak, and, on an examination being made, a round hole, about 1 inch in diameter, was found in the copper sheathing of the vessel. Those who had insured the ship claimed £3000 on the ground that the injury had been inflicted by one of these fish, while the insurance company contended that some other cause had been at work. After a protracted trial the jury returned as a verdict that the damage had been caused "by contact with some substance other than water, and that probably it was caused by a swordfish." In the Field for May 14th, 1881, it is recorded that the Liverpool barque "Junak" had been injured by one of these fishes, and that a distinct shock was believed to have been felt at the time of the blow.

Although the *Histiophorus* is taken off the Madras coast in large seine nets, such a mode is not found successful in the Mediterranean, where the *Xiphias* has a more cutting edge to its sword, while the method of capture appears to have remained unchanged for centuries. A man ascends one of the cliffs which overhang the sea, and as soon as he spies the fish, gives notice, either by his voice or by signs as to the course it has taken. Another individual in a boat climbs the mast, and on seeing the fish directs the rowers to it. As soon as he considers that they have got within reach, he descends, and taking in his hand a harpoon to which a cord is attached, strikes it into the fish, sometimes from a considerable distance. After struggling for some time the exhausted animal is dragged into the boat, the whole process somewhat resembling a whale fishery on a miniature scale.

Genus I.—Xiphias, *Artedi.*

Machæra, Cuvier.

Branchiostegals seven: pseudobranchiæ well developed. Body elongated and somewhat compressed. The upper jaw flattened, sword shaped and (except in the very young) much produced beyond the lower jaw. No teeth in the jaws, vomer, or palatine bones. Gill-openings wide. Two dorsal fins in adults (one in the young). No finlets. Ventrals absent. Two anal fins in adults (one in the young). Caudal forked. Scales rudimentary: a raised keel along the middle of the side of the tail. Air-bladder present. Pyloric appendages many.

In the young, as when 190 millim. long, the two jaws, observes Lütken, are well armed with comparatively strong teeth. All the body, including the head and the rostrum, is clothed with non-imbricated scales, which are keeled and ciliated —that is to say, furnished with spines or teeth upon the keel. Two rows of these scales, which strike one by their size, extend along the back on each side of the dorsal fin, and two others along the belly on each side of the anal fin. These scales are present in the youngest *Xiphias*, whereas they are absent from *Histiophorus*. Young examples of *Xiphias* have transverse bands of colour.

* See *Alopecias vulpes* for further remarks on this question.

1. Xiphias gladius, Plate XLIX, fig. 1 and 2.

Ξιφίας, Arist. ii, c. 13, 15, viii, c. 19; Athen. vii, p. 314; Ælian, ix, c. 40, xiv, c. 23; Oppian, i, 8, ii, 48.

Xiphias, Ovid. Hal. v, 67; Pliny, lib. xxxii, c. 2; Rondel. viii, c. 15, p. 251, c. fig.; Gesner, p. 1049 and 1598, f. 20, c. fig.; Artedi, Syn. p. 30. *L'Heron de mer*, Bellon. *Xiphia seu gladio*, Jonston, De Pisc. lib. i, tit. 1, c. i, Art 3, t. iv, f. 2. *Swordfish*, Willughby, Ich. p. 161, t. l, 27, f. 2; Ray, p. 52; Pennant, Brit. Zool. (Ed. 1) iii, p. 160, pl. xxvi (Ed. 2), iii, p. 216, pl. xxx. *Spada*, Cetti, Hist. Sard. iii, pp. 93, 94, 145. *Poisson a Epée*, Duhamel, ix, p. 334.

Xiphias gladius, Linn. Syst. i, p. 432; Bloch, t. lxxvi; Gmel. Linn. p. 1149; Bonnaterre, Ency. Ich. p. 42, pl. xxvi, p. 92; Lacép. ii, p. 290, pl. ix, f. 1; Bl. Schn. p. 93; Shaw, Zool. iv, p. 99, pl. xiv; Flem. Brewster's Journal, ii, p. 187, and Brit. An. p. 220; Turton, Brit. Fauna, p. 88; Risso, Ich. Nice, p. 99 and Eur. Mérid. iii, p. 208; Cuv. and Val. viii, p. 255, pl. ccxxv, ccxxvi; Storer, Report, p. 51; Yarrell, Brit. Fish. (Ed. 1) i, p. 143, c. fig. (Ed. 2), i, p. 164 (Ed. 3), ii, p. 240; Jenyn's Manual, p. 364; Parnell, Fishes Firth of Forth, p. 55, and Wern. Mem. vii, p. 215; Cuv. Règne Anim. Illus. Poiss. pl. l, f. 1, and pl. li, f. 2, and pl. liii, f. 2; Demid. Voy. Russ. Mérid. iii, p. 393; Swainson, Fishes, ii, p. 239; Thompson, An. and Mag. (2), 1846, p. 314, and Nat. Hist. Ireland, iv, p. 95; Guichen. Expl. Sc. Algér. Poiss. p. 60; White, Catal. Brit. Fish. p. 33; De Kay, New York Fauna, p. 111; Lowe, Trans. Zool. Soc. iii, p. 5; Nilss. Skan. Fauna, p. 147; Günther, Catal. ii, p. 511; Steind. Sitz. Ak. Wiss. Wien, lvii, p. 396, or Ich. Span. u. Port. 1868, p. 46; Schlegel, Dieren Neder. p. 10, pl. i, f. 3, 4; Hector, Trans. New Zealand Inst. vii, p. 246; Collett, Norges Fiske, p. 51; Winther, Ich. Dan. Mar. 1879, p. 16; Giglioli, Catal. Pesc. Ital. 1880, p. 28; Lütken, Spol. Atlan. p. 592; Moreau, Poiss. France, ii, p. 526.

Xiphias Rondeletii, Leach, Wern. Mem. ii, p. 58, pl. ii, f. 1, and Zool. Misc. i, p. 62, pl. xxvii.

Swordfish, Couch, Fish. Brit. Isles, ii, p. 145, pl. xcvii.

B. vii, D. 3/43, P. 15, A. 17, C. 21.

In the example figured, which is 30 inches long, the extreme length of the head equals the distance between the head and base of the caudal fin. *Eye*—$3\frac{1}{4}$ diameters in the postorbital portion of the head. Interorbital space nearly flat. Angle of preopercle crenulated. Snout depressed and flattened: the cleft of the mouth reaching to nearly 1/2 a diameter posterior to the orbit. The different proportions vary with age, and in the very young there are some denticulations above the orbit, and two short spines at the angle of the preopercle. *Teeth*—true ones absent. *Fins*—vary exceedingly with age: in the very young (see page 148) the dorsal fin commences on the occiput and is continued until near the tail, but it is slightly elevated anteriorly; in the rest of its course it is several times higher than the body. As the fish increases in age, as about $2\frac{1}{2}$ or 3 feet in length (plate xlix), the middle portion of the dorsal fin commences to decrease in height, showing the anterior rays much elevated and also the last few. The middle portion becomes more and more absorbed, until in the adult there are two distinct dorsal fins. The anal undergoes a transformation similar to the dorsal. Pectoral placed very low down and falciform. *Scales*—rudimentary, seen in the very young in the form of two rows along the side of the dorsal fin, and also along the abdominal edge. *Air-bladder*—large, and with thin walls. *Colours*—back and upper half of the body of a dull blue or brownish blue, becoming white on the sides and beneath. The young have transverse bands.

Varieties.—It is possible that the following are merely varieties of this species, but sufficient materials hardly exist in museums at present to decide the question. *Xiphias nigricans*, Lacépède, and *Histiophorus gracilirostris*, Cuv.: also *Xiphias velifer*, Cuvier. The lateral keel on the side of the tail may be double, and the dorsal fin lower or higher than the trunk.

Names.—*Swordfish*, so named from its elongated snout, also *rasour* (Halliwell). *Zwaardvisch*, Dutch. *L'Espadon*, French.

Habits.—This fish is very swift in its movements, wary and vigilant against surprises, and but seldom seen alone, generally going in pairs. It frequently migrates along with the tunnies, which some believe it does for company, others in order to attack them. It is occasionally taken in brackish or even fresh water, especially the Severn. As already observed (page 144) due to some cause these fishes attack whales and objects often larger than themselves, and the question forces itself upon our consideration if this is done from the desire to obtain food or whether the animal is possessed of such a morose disposition that it is in a constant state of warfare. In the Weston-super-Mare Museum is the cast of one of these fishes, 9 feet long, captured in 1873 near the town. On its left side, opposite the hind edge of its first anal fin, existed a large cicatrix, evidently due to a wound consequent on an injury which had nearly transfixed it, there being a spot on the opposite side showing to where the injury had extended. The appearances seemed to show that it had been inflicted by another of the same family, perhaps during the breeding season. Such may, however, be simply an instance of matrimonial infelicity, for Lacépède considered that in spite of some of its actions its habits are gentle and its affections lively. In short, he remarked that if the shark were compared to a tiger, the swordfish might be classed with the lion.

According to Couch, in August, 1861, near Westra, a Herring-hog (a species of small whale) was attacked by a swordfish, and when thus compelled to leap out of the water, which it did to the height of 6 feet, it was observed that the sword had been thrust into the whale's body behind the pectoral fins. Its leaps continued, and then it was perceived that a thrasher was assailing it on the sides.

Bloch states that this fish sometimes feeds upon vegetable substances. Fleming found the remains of *Loligo sagittata* in the stomach of one he examined. Leach discovered some small fish inside a large one. Pilchards have been observed in them, while they have been taken on a baited hook.

Means of capture.—As their sharp, depressed, and laterally cutting snouts are destructive to nets, the harpoon is preferred as an implement for taking them in seas where they abound. Brydone has given an account of harpooning these fishes in Sicily. A scout, perched on the mast of a vessel, notifies to his comrades when he perceives a "spada": then they all commence a chaunt which is believed to be indispensable to success, and alluring the fish to his destruction. The harpooner throws his implement at his victim, which he rarely misses. Should, however, a single word of Italian be uttered the spell from the chaunt is broken, and the fish plunges down into the vasty deep, from which it will not again be charmed. In the Mediterranean a regular fishery exists for their capture. Oppian describes the mode pursued as follows. A bait was fastened by means of a sliding noose to the line at some distance above the hook, and it was so contrived that when the fish seized the bait it glided along until the hook stopped its progress when the fishermen knew by the jerk that it was time to haul tight the slip knot.

Mr. North, in a 6-oared galley, captured one October 20th, 1843, 10 feet long, off Deal, "a little way to the south of the outer beacon leading to Sandwich Haven. He saw the fish in about 4 feet of water, rowed towards it, and observed that it appeared far exhausted in strength: he then ventured to put a small rope with a running noose over its tail, and after playing with it some time succeeded in putting other ropes round the fish, and got it on board" (Zoologist, 1843, p. 85).

Couch mentions one taken in drift nets in October, 1861, near Land's End: and in June, 1879, one 11 feet long, became entangled in mackerel nets off Eddystone lighthouse, and after two hours' exertion, was hauled on board. It is known to cause great injury to nets, and even to escape by cutting its way out by means of its sword-shaped snout.

As food.—Its flesh has been reported as excellent. Mr. Gurney (Zool.

1861, p. 7819) states respecting one captured in Norfolk, that its flesh when dressed was white, palatable, and not unlike that of the sturgeon. Linnæus compared it to salmon. It is dressed in Italy in a manner similar to that employed for the tunny, than which it obtains a higher price.

Diseases.—It is occasionally perceived springing out of the water, attributed by some to exuberance of joy, by others to the irritation of parasitic worms. *Philichthys xiphiæ*, Steenst. (see An. and Mag. 1868 (4), i, p. 303), is a parasite found in this fish. Couch gives an instance on the authority of a sailor, in which one of these fishes, 8 or 9 feet long, was seen closely pursued by a blue-shark, and was twice observed to leap out of the water to escape its pursuer. The result of the chase was not ascertained.

Habitat.—In Europe it extends from Scandinavia, the Baltic, North Sea, and Atlantic through the Mediterranean. Also in the Atlantic down the western shores of Africa to near the tropics. In the western hemisphere it is occasionally taken in Newfoundland, and is distributed from Nova Scotia to the West Indies. It has also been recorded from the southern hemisphere (Hector, Trans. New Zealand Inst. vii, p. 246, likewise Cheeseman, l. c. viii, p. 219, and Hutton, l. c. p. 211).

During the summer and autumn, mostly from July and until even as late as November, it is not uncommon around the coasts of Great Britain, more especially on the south and south-west, while it is not unfrequently taken in the Bristol Channel and Estuary of the Severn. In October, 1862, one, 9 feet 1 inch long, was taken in Essex, it had driven its sword into the mud and was captured alive, when it was found that due to an old standing injury the end of its snout was wanting. In October, the previous year, one, 9 feet 5 inches long, was found partially stranded off the Norfolk coast, and drawn ashore by a noose being placed over its tail (T. Gurney, Zool. p. 7819). In September, 1863, one, 7 feet 7 inches long and weighing 147 lb., was entangled in a pilchard drift net off Plymouth: in its stomach were found pilchards and cuttle fishes (J. Reading, Zool. p. 8932). In August, 1878, one, 8 feet 7 inches long and weighing 138 lb., was taken by means of a hook and line at Mount's Bay, Cornwall (Cornish, Zool. p. 351): in July, the same year, a female, 9½ feet long and weighing 3½ cwt., was taken in a drift net off Devonshire (Gatcombe, Zool. p. 351). July 14th, 1879, one, 9½ feet long, was taken off the Norfolk coast in a mackerel net (Gurney, Zool. p. 342). Numerous others are recorded. In Banffshire Edward mentions a small example captured by a shrimper.

The remains of a portion of one taken in a net on the Wexford coast in 1786, were sent to the Dublin University Museum.

The example (No. 1) figured, is 30 inches long, for which I am indebted to Dr. Hubrecht, of Leyden: the smaller one, figured half natural size, is in the Leyden Museum: it is said to attain to 15 feet in length.

YOUNG OF XIPHIAS.

Fourth group—Acanthopterygii Sciæniformes.

Muciferous system on the head well developed. The soft dorsal usually much more developed than the spinous, or than the anal. No pectoral filaments.

Family, XV—SCIÆNIDÆ, *Cuvier.*

Branchiostegals seven: pseudobranchiæ sometimes concealed or even absent. Body somewhat compressed and rather elongate. Eyes lateral, of moderate or small size. Mouth in front of or below the snout. Cheeks unarmed: preopercle without any osseous articulation with the suborbital ring of bones; opercles sometimes with weak spines. Barbels present in a few genera. Muciferous system on the head well developed. Teeth in villiform bands, the outer or the inner row of which are often enlarged: canines present in some genera, but neither cutting nor molar-form ones in the jaws: palate edentulous. Two dorsal fins, the spines (8-12) of the first usually feeble, the second much more developed (22-43 rays) than the first: anal with one or two spines and much fewer (5-16) rays than the second dorsal: pectoral rays branched and without free filaments: ventral thoracic with one spine and five rays. Scales ctenoid or cycloid, covering the head and snout, placed in oblique and often sinuous rows on the body. Lateral-line complete, often continued on to the caudal fin. Stomach cœcal. Air-bladder, when present, as a rule with branching or elongated appendages. Pyloric appendages usually few.

In tropical countries, where these fishes are extensively distributed, the rays pertaining to the second dorsal fin are found to be liable to great variation in number, while the caudal becomes more obtuse as the adult stage is arrived at. The scales are placed in oblique rows, and the number along the lateral-line rarely corresponds with what exists in the row above or that below it. The eye, likewise, is comparatively much smaller in adults than in the young.

Uses.—The air-bladders of many of these fishes are extensively collected along the coasts of India as they afford a rough isinglass which meets with a ready sale in China. As food their flesh has always appeared to me as tasteless when young, coarse when old.

As regards classification Bleeker (Mém. sur les Sciénoides, 1874) has questioned the utility of separating the genus *Sciæna* from the genus *Umbrina* merely because the latter possesses a short central barbel beneath the symphysis of the lower jaw. In a few Asiatic forms a rudimentary barbel is found in some examples of *Sciæna*, while the dentition forms a truer guide than the size and length of the second anal spine. The two accepted British genera are *Sciæna*, without a barbel under the chin, and *Umbrina*, with a barbel at that place, but believing the latter genus has been recorded due to an error, I have omitted it.

Geographical distribution.—The fishes of this family, some of which attain to a large size, are extensively distributed in the tropical and contiguous portions of the Atlantic, Indian, and North Pacific Oceans, extending into the sub-tropical parts. They are also found in the Mediterranean, and wanderers are sometimes taken on the south coast of Great Britain, or even further north. Some are spread through the fresh waters of the United States. They are almost absent from the Pacific Ocean: none have been recorded from Polynesia, and merely two or three from Australia. In the clear waters of the Red Sea they are unknown, but abound along the coasts of India, especially wherever there are estuaries or the openings of rivers. They pass up tidal waters even to far above where they have ceased to be brackish, and this they do in order to prey on their weaker neighbours. They prefer muddy bottoms to clear water, and where marine siluroids abound in the tropics Sciænoids are rarely far off.

Genus I.—Sciæna (*Artedi*), *Cuvier.*

Johnius, Bloch: *Corvina* and *Stellifer*, Cuvier: *Bola*, sp. Ham. Buch.: *Leiostomus*, Cuv. and Val.: *Coracinas*, Pallas: *Homoprion*, Holb.: *Amblyodon*, Raf.: *Cheilotrema*, v. Tsch.: *Genyonemus*, *Plagioscion*, *Sciænops*, *Bairdiella*, *Haploinodotus*, *Rhinoscion* and *Ophioscion*, Gill: *Diplolepis*, Steind.: *Pseudosciæna*, Bleeker.

Branchiostegals seven: pseudobranchiæ present. Body oblong, rather elongated and compressed. Eyes of moderate size. Interorbital space broad, convex. Snout rounded, sometimes overhanging the upper jaw, which last is longer than the lower, or both are of about equal length. Cleft of mouth nearly or quite horizontal. No central barbel beneath the symphysis of the lower jaw. Teeth villiform, with an outer enlarged row in the premaxillaries, and sometimes the inner row in the mandibles is enlarged. No distinct canines. Two dorsal fins, the first with 9-10 *spines and connected at its base to the second which is of moderate length* (23-32 *rays*). *Anal with one or two spines. Scales ctenoid or cycloid, extending over the head and snout, and generally more or less present over the bases of the vertical fins and on the tail. Air-bladder present* (*except in some American species*). *Pyloric appendages in moderate numbers or few.*

Bleeker divided this genus into *Pseudosciæna* having the inner row of teeth in the lower jaw distinctly the larger, and *Johnius* without any such enlarged row.

Salvianus considered the term *Sciæna* derived from σκιὰ, a shade or shadow, denoting the rapidity of its movements as it flits through the water: Rondelet, however, considered the shadows or bands related to the markings on the sides of the fish. M. Dufossé states that the sounds emitted by these fishes have a mean of twenty-five seconds, and also various notes, usually degenerating into a humming sound, either from an excess or want of intensity. He suggests that the song of the fabled Sirens had its origin in the utterances of shoals of maigres, and tells us also, on what he believed to be reliable testimony, that a sea captain going up the Gironde when he first heard the maigres song, was thrown into great alarm, supposing that his vessel had sprung a leak and water was flowing into his hold.

Geographical distribution.—From Scandinavia to the British shores and Mediterranean, through the Atlantic, Indian, and North Pacific Oceans, being most abundant in their tropical portions. Also the fresh waters of the United States.

Some ascend fresh water rivers, as the *S. coitor*, H. B., in India: while others as *S. Richardsonii*, C. V. reside entirely in Lake Huron.

1. Sciæna aquila, Plate L.

Σκίνα, Aristot. Hist. Anim. viii, c. 19.

Latus, Rondel. v, c. 10, p. 135, c. fig.; Gesner, ed. 1598, f. 29, c. fig. *Umbra*, Salvian. fol. 105*a*; Belon. pp. 117, 119. *Sciæna sive Umbra*, Jonston, De Pisc. lib. i, t. ii, c. 1, art. 13, p. 51, t. xv, f. 9. *Umbra Rondeletii*, Will. p. 299, t. S 19. *Maigre*, Duhamel, Pêches, ii, sect. vi, p. 137, pl. i, f. 3.

Labrus hololepidotus, Lacép. iii, p. 517, pl. xxi, f. 2.

Sciæna umbra, Lacép. iv, p. 314; Cuv. Mém. Mus. i, p. 1 and Règne Anim.

Cheilodipterus aquila, Lacép. v, p. 685.

Perca vanloo, Risso, Ich. Nice, p. 298, t. ix, f. 30.

Sciæna aquila, Risso, Eur. Mérid. iii, p. 411; Cuv. and Val. v, p. 28, pl. c; Neill, Edin. New. Phil. Journ., April, 1826, p. 135; Flem. Brit. Anim. p. 213; Parnell, Fish. Firth of Forth, p. 40, and Wern. Mem. vii, p. 200; Yarrell, Brit. Fish. (Ed. 1), i, p. 90, c. fig. (Ed. 2), i, p. 104 (Ed. 3), ii, p. 104; Nilss. Skan. Fauna, p. 756; Cuv. Règne Anim. Ill. Poissons; Jenyns, Man. Brit. Vert. p. 352; Thompson, N. H. Ireland, iv, p. 90; White, Catal. Brit. Fish. p. 16; Günther, Catal. ii, p. 291, and Mus. Godef. ix, p. 105; Schlegel, De Dieren Neder. p. 21, pl. ii, f. 3; Steind. Ich. Span. u. Port. 1867, p. 38; Winther, Prod. Ich. Dan. Mar. p. 12; Giglioli, Cat. Pesc. Ital. 1880, p. 24; Moreau, Poiss. France, ii, p. 398.

Sciæna hololepidota, Cuv. and Val. v, p. 53; Quoy and Gaim. Voy. Astrol. Poiss. p. 697, pl. xii, f. 1.

Sciæna Capensis, Smith, Ill. S. African Fishes, pl. xv.

Sciæna Antarctica, Castelnau, Pro. Zoo. Soc. Vic. 1872, p. 100.

Sciæna, Couch, Fish. Brit. Isles, ii, p. 54, pl. lxxvi.

B. vii, D. 9-10/$\frac{1}{26-29}$, P. 17, V. 1/5, A $\frac{2}{7}$, C. 15, L. l. 52-55, L. tr. 8-9/17-19, Vert. 11-13, Cœc. pyl. 12.

Length of head 4, of caudal fin $6\frac{1}{4}$, height of body $4\frac{1}{4}$ to 5 in the total length. *Eye*—Diameter, $5\frac{1}{2}$ to 6 in the length of the head, $1\frac{1}{2}$ diameter from the end of the snout, and 2/3 to 1 diameter apart. Snout rather pointed; the maxilla reaches posteriorly to beneath the last third of the eye. Preopercle serrated along its posterior edge and with denticulations at the angle, these become obsolete with age. Two flattened opercular spines. *Teeth*—A row of somewhat distantly placed, slightly curved, and pointed ones in the jaws, strongest in the upper; there are also some finer teeth. None on the vomer, palatine bones, or tongue. *Fins*—spines of the first dorsal weak, the third and fourth the longest, and equal to about half of the height of the body below them; this fin is united at its base with the second dorsal, which is of less height than the first, and continued nearly to the root of the tail. Anal commences below the fifth or sixth ray of the second dorsal, its first spine short, the second longer but scarcely above half the height of the first ray. Pectoral nearly two-thirds as long as the head. Ventral of about the same length. Caudal truncated or rounded. *Scales*—ctenoid, and in oblique rows. *Lateral-line*—with a very gentle curve from its origin to above the anal fin, where it becomes straight and is continued along the caudal fin to its extremity: the tubes are branched posteriorly. *Air-bladder*—large, and possessing many lateral branching processes. *Colours*—grayish, darkest along the back, the occiput being of a greenish tinge, with purple and golden reflections, and a gray blotch on the opercle: the back with a coppery tinge becoming silvery white along the sides and beneath. The colours are subject to considerable variations, due to seasons as well as to the character of the water they inhabit. The fins, excluding the caudal, are usually of a red colour, having the outer edge of the second dorsal, pectoral, anal, and caudal gray.

Names.—Rondelet considered *Coracinus* to be a small, and *Latus* a large example of this fish among the Roman fishmongers. The *Peis Rei*, or Royal fish, of Languedoc Lacépède believed identical with *Latus*. *Shade-fish*. *Maigre*, French, not signifying thin, but derived from the whiteness and bloodless appearance of the flesh, the orthography *meagre* being therefore erroneous. The Dutch are said to perceive an image or representation of the Virgin on each scale. *Ombervisch*, and *Onzelieve vronwvisch*, Dutch.

Habits.—Bold and fearless, of great strength, gregarious, and fond of changing its locality. Uttering sounds below the water which have been compared to bellowing, buzzing, purring, and whistling—this, some fishermen have imagined, is only effected by the males during the breeding season. It has been recorded that listening to this sound, shoals or troops of them have been successfully netted. It has also been stated that they can be heard when at twenty fathoms depth. Couch says that for a few years in succession, from 1849, they attended on the boats which were engaged on the pilchard fishery on the south coast of Cornwall; and although they never attempted to take fishes from the floating nets, the eager *Sciæna* would dart greedily after any that fell out of them, or were thrown to it, and in doing so its appetite could scarcely be satisfied. Attempts to catch them were unsuccessful, as they snapped the best lines. Mr. D'Urban found in the stomach of one, on October 3, 1872, six monk-fish, each about 1 foot long; six small pilchards, and a small sole.

Means of capture.—Netting and trammels.

Breeding.—In the Mediterranean the largest numbers of young of this fish are found on the southern side, where they generally swim in small shoals.

As food.—Formerly much prized in Rome, and even now it is esteemed on some parts of the continent, where the head and shoulders are deemed the most tempting portions. In the East I have tried fishes of this genus frequently, but

always found them insipid and anything but firm. Yarrell remarks that stewing is better for this fish than boiling, as they are rather dry and tasteless.

Diseases.—Mr. D'Urban found adhering to the scales of one several specimens of the Holibut leech, *Entobdella hippoglossi.*

Uses.—The "otoliths," or ear stones, are comparatively large in Sciænoids, and were formerly deemed very efficacious against colic, provided they had been received as gifts, as purchased ones were believed to lose their virtue. They were mounted in gold and worn suspended round the neck. The Roman fishermen were accustomed to present the head, as a species of tribute to the three magistrates of Rome who acted as conservators of the city.

Habitat.—Nilsson has recorded its occurrence on the coast of Sweden, in December, 1852, from there it extends to the British Isles, becoming somewhat rare in the Bay of Biscay, but found through the Mediterranean, being common in the Gulf of Gascogne from July until September, but much less frequent towards Italy. It is also present in the Atlantic, round the Cape of Good Hope, and south coast of Australia; these Antartic examples have been named *Sciæna antarctica* by Castelnau.

One was captured in Zetland, in November, 1819, endeavouring to escape from a seal (Neill), and a second in the Orkneys by Dr. Duguid in 1852 (W. Baikie). It is often taken along the coasts of Cornwall and Devonshire, mostly during the summer and autumn, and sometimes in considerable numbers. Mr. Holdsworth obtained a fish which he considered this species taken by a seine, at Start Bay, on the south coast of Devonshire in August, 1825 (Pro. Zool. Soc. 1831, p. 112); it is probable that the fish weighing 100 lb., taken in the Exe, was also this species (Linn. Trans. xvi, p. 751, Nov. 20th. 1827) and not *Umbrina cirrhosa* which the Exe example has been supposed to represent in the British Fauna. The chief difficulty is that in the minute book of the Linnean Society it is stated that Mr. Cresswell's fish from the Exe proved to be identical with *Sciæna cirrhosa* of Linnæus. But as this form only attains 30 or 40 lb. weight in the Mediterranean, and no other instance besides this single 100 lb. fish has been recorded, the drawing to which the name was given was probably untrustworthy. Parnell (1838) mentions one 3½ feet long from the Firth of Forth. In 1841 one was captured at Sherringham, and is now in the Norwich Museum; another in the autumn of 1843, was taken off Mevagissey, it was 6 feet long and of about 400 lb. weight (R. Couch); and in October in the same year one off Margate (Zool., p. 85). In the winter of 1844, another off Fowey. In 1847 a fine one off Craster (Proc. Berwick. Nat. Club, 1867, p. 343): December 24, 1849, one 5 feet long, from between Redcar and the Tees' mouth (Zool. viii., 1850): and another in August from Dartmouth. At the end of October, 1850, one upwards of 100 lb. was taken off Brixham (Times, Nov. 4th, 1850): in 1863 one over 5 feet long by trawlers, in Carmarthen Bay, it weighed 64 lb., D. 8/28, A. 8 (Williams, Zool., p. 8771); the same year Cornish recorded another from Penzance. July 21st, 1866, Buckland mentions the head of one sent him by Mr. Charles, and he recorded five others that year; in 1867, one 3 feet long was taken at Hastings: in 1868, on November 22nd, after a rough night, one was driven ashore opposite the Marine Parade at Brighton, it weighed about 70 lb. (Brighton Herald, Nov. 28th): while on August 30th of the same year, another, rather over 5 feet long, and weighing 84 lb., came ashore at Thorpe near Aldborough (Lowe, Fauna of Norfolk). October 3rd, 1872, one was taken at Teignmouth in a pilchard seine, it was 5 feet long, and weighed 74 lb. (W. D'Urban); and in August 30th, 1880, the same author recorded another captured at Beer, off the Devonshire coast (Zool. 1880, p. 449).

In Ireland, according to Dr. Harvey (Cork Fauna), one 6 feet 4 inches in length was captured August 1st, 1840, while basking on the surface of the water opposite the passage into the harbour of Cork.

The specimen figured is about 21½ inches in length, it was captured June 20th, 1881, in a trammel at Mevagissey and kindly sent me by Mr. Dunn. It attains to at least 6 feet.

Fifth group—Acanthopterygii Trichiuriformes.

Body elongated, band-like, and strongly compressed. Cleft of mouth deep. Several strong and conical teeth in the jaws or palate. Dorsal and anal fins many rayed, sometimes ending in finlets. Caudal fin, when present, forked.

Although the flattened snake-like fishes are mostly found residing at great depths, this is not invariably the case: thus, in tropical climates, the *Trichiurus* usually frequents the littoral regions at very inconsiderable depths, although it may also be seen as a surface fish some distance from land. It is so also in China, "off the Regent's-sword, or Lian-tie-Shan promontory, great numbers of strange-looking crafts in the form of rude rafts, put boldly to sea, long black nets coiled up snugly in the middle, four men working at huge sculls, and the others smoking and chatting. The net is paid out in a circle, and when the end is come to, the net is turned back and hauled in, securing frequently large numbers of the silvery hair-tail."—(A. Adams, Zool. 1861, p. 7517.)

Family, XVI—TRICHIURIDÆ, *(Swainson) Günther.*

Lepidopodinæ, Gill.

Branchiostegals seven or eight: pseudobranchiæ present. Body elongated and strongly compressed. Gill-openings wide. Eyes lateral. Cleft of mouth deep. Teeth in jaws or palate, several being strong and conical. Dorsal and anal fins many rayed, sometimes ending in finlets: ventrals, when present, thoracic, sometimes rudimentary: caudal present or absent. Scales, when present, rudimentary. No prominent papilla behind the vent. Air-bladder present. Pyloric appendages few or many.

Genus I.—Trichiurus, *Linnæus.*

Enchelyopus, Klein; *Lepturus* (Artedi), Gill; and *Eupleurogrammus*, Gill.

Branchiostegals seven: pseudobranchiæ present. Body very elongated, strongly compressed, ribbon-shaped, tapering to a finless point at the tail. Cleft of mouth deep. Teeth in jaws and palatines, those in the premaxillaries being arched and very strong, while the lateral ones are lancet-shaped; none on the vomer. A single long dorsal fin, extending the entire length of the back: ventrals, when present, in the form of a pair of scales or spines: anal spines minute, sometimes concealed beneath the skin. Scales absent. Air-bladder present. Pyloric appendages numerous.

Although ventral fins merely exist in one or more of these species in the form of spines or scales, it is suggested by Lütken as not improbable that they are always present in the very young. This is a littoral genus which is sometimes taken out at sea. Cantor observed that *Trichiurus haumela* and *T. savala* give at certain seasons, like other fishes, a vivid phosphorescent light.

As food these fishes are held in various estimation at different places. Thus along the coast of Beloochistan, where salt is cheap, no one will touch them; along the coast of India, where the onerous salt tax has ruined the fish-curers' trade, they are more valued, because their bodies being attenuated they can be dried in the sun. Europeans have spoken well of them as articles of diet.

Geographical distribution.—Tropical seas extending into those of temperate regions. Stragglers occur along the British coasts.

1. Trichiurus lepturus, Plate LI., Fig. 1.

Seba 33, 1: *Lepturus*, Artedi, Spec. p. 111; Linn. Mus. Ad. Fried. i, p. 76, pl. xxvi, f. 2. *Gymnogaster*, Linn. Syst. Nat. p. 53; Gronov., Mus. Ich., i, p. 17; Brown, Jamaica, p. 444, t. xlv, f. 4. *Enchelyopus*, Klein, MSS. iv, p. 52, pl. xii, f. 7.

Trichiurus lepturus, Linn. Syst. Nat. i, p. 429; Hoy, Trans. Linn. Soc. xi, p. 210 (? synon.); Bloch, t. 158; Gmel. Linn. p. 1141; Bl. Schn., p. 517; Flem. Brit. An., p. 204; Cuv. and Val. viii, p. 237; Jenyns, Man. p. 372; Yarrell, Brit. Fish (Ed. 1) i, p. 182, c. fig. (Ed. 2) i, p. 204 (Ed. 3) ii, p. 275; Swainson, Fishes ii, p. 254; Storer, Boston Journ. iv, p. 181; Castelnau, Anim. Amér. Sud., p. 24; De Kay, New York Fauna, Fishes, p. 109, pl. xii, f. 35; Guichen. in Ramon de la Sagra, Hist. Cuba, p. 105; White, Catal. Brit. Fish, p. 33; Günther, Catal. ii, p. 346, Gill, Proc. Acad. Nat. Sc. Phil. 1864, p. 205: Andrews, Proc. Roy. Dublin Soc. vi, p. 35; Steind. Ich. Span. u. Port., 1867, p. 102; Moreau, Poiss. France, ii, p. 547.

Trichiurus argenteus, Shaw, Zool. iv, p. 90, pl. xii; Mitchell, Trans. Lit. and Phil. Soc. New York, i, p. 364.

Hair-tail, Couch, Fish. Brit. Isles, ii, p. 61, pl. lxxviii.

Lepturus argenteus, Gill, l.c. 1863, p. 226.

B. vii, D. 135-136, P. 11, Cœc. pyl. 24, Vert. 39/120.

Length of head 9 to 10, height of body 16 to 17 in the total length. *Eye*—diameter 6 in the length of the head, and situated in its anterior half, 2 diameters from the end of the snout and 1 diameter apart: interorbital space nearly flat. Lower jaw the longer, the posterior extremity of the maxilla reaches to beneath the middle of the eye. The height of the body commences to diminish at about the centre of its total length, ending in a slender tail. *Teeth*—about 15 in a single row in either jaw, and two pairs of strong canines with barbed extremities in the premaxillaries: no teeth on the vomer or tongue, but fine ones on the palatines. *Fins*—the dorsal commences above the anterior border of the opercle, and is continued, but in greatly-decreasing height, to within a moderate distance of the caudal extremity. Pectoral short. Ventrals, anal, and caudal absent. *Lateral-line*—descends behind the pectoral fin until it reaches the lower third of the height of the body. Anus situated at about 1/3 the length of the fish, behind it spiny points commence. *Colours*—of a beautiful silvery, which exists in a fine and deciduous membrane, that is easily rubbed off.

It is remarkable that the first reputed record of this fish off the British coast came from Mr. Hoy, who described two fishes under this name in the "Transactions of the Linnean Society." One appears to have been *Regalecus Banksii*, while it is doubtful to what genus the other, taken in 1810, is to be referred unless to *Lepidopus*, as a caudal fin is alluded to; also it was nearly 4 feet in length. As Fleming, Yarrell, Jenyns, and White admitted this species solely owing to Hoy's description, it seems possible that up to the time that Couch first described a British example of *Trichiurus lepturus* the species had not been recorded as captured in British waters.

Names.—The *hair-tail* or *silvery hair-tail*, *blade fish*, all of which designations refer to its external shape or colour.

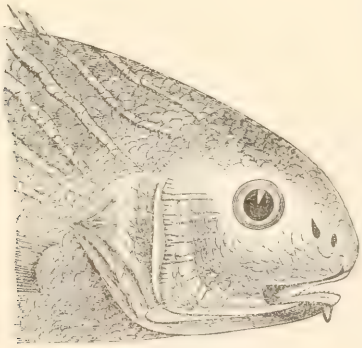
Habits.—Although generally a shore fish, it is frequently found far out to sea, as already mentioned. The young in the tropics are also sometimes captured at the mouths of rivers. One upwards of 2 feet long was taken in 1876 in St. Germain's river in Cornwall. The most frequent time of the year the hair-tail shows itself is during the winter months. They are said occasionally to leap out of the water into boats.

As food.—Russell, in his Fishes of Vizagapatam, observes that in his time the European soldiers on the Coromandel coast esteemed these fishes; and Jerdon remarks that they afford very delicate eating when fresh, though never brought to the table of Europeans at Madras.

Habitat.—The Atlantic Ocean, being found on the east coast of North America from Cape Cod to Florida, and the West Indies. Wanderers have been taken off the British and Irish, and more rarely off the French coasts.

Couch figures the first authentic British specimen of this fish; it was 2 feet 3 inches long, and was thrown on shore off Whitesands Bay, near Land's End, in Cornwall, in April, 1853. Mr. Dunn observes that they were common in the winter months from 1865 to 1875, but scarce both before and since that period. Mr. Couch before his death had many specimens. In April, 1867, one 2 feet 9 inches long was taken in a mackerel-boat in Mount's Bay (Zool. 1867, p. 793). December 3rd, 1870, Mr. Cornish recorded one 2 feet 5 inches long taken in Mount's Bay, and alludes to another captured a fortnight previously (Zool. 1871, p. 2444), also on December 6th one 2½ feet long, another subsequently, and one in January, 1871 (l. c., p. 2549). On November 29th a specimen was taken in a herring-net four miles from Looe, and Mr. Laughran obtained three more from the same place and one from Plymouth, all captured within a few days of each other (S. Clogg, Zool. p. 2445). In February, 1871, a "hair-tail" was taken in Devonshire and another in Cornwall (T. Gatcombe, Zool. p. 2529). November, 1871, one 2½ feet long was found dead in Mount's Bay (Cornish, Zool. 1872, p. 2908) and on December 10th another, almost as long, at Swanage, in Dorsetshire (Colson, Hardw. Sc. Gossip, 1872, p. 17). In the same publication an example is recorded as taken on January 4th, 1872, at Helford Harbour, on the S.W. coast. On February 1st Mr. Cornish states one was taken in Whitesands Bay, near Land's End (Zool. 1872, p. 3127). Mr. Gatcombe in 1876 recorded one taken January 28th 2 feet 5 inches long from the St. Germain's River, Cornwall, and another 2 feet 8 inches long on January 29 from Homoaze, near Plymouth (Zool. 1876, pp. 4806, 4887).

Andrews records this fish from the Irish coast, while two were captured there in February, 1871, and during the earlier months of 1872 five specimens were taken in Dingle and Tralee Bays, Kerry, S.W. of Ireland (Hardw. Sc. Goss. p. 113).



HEAD OF UMBRINA CIRRHOSA.

Genus II.—Lepidopus, *Gouan.*

Vandellius, Shaw. *Scarcina*, Rafinesque. *Zipotheca*, Montagu.

Branchiostegals seven or eight: pseudobranchiæ present. Body elongated and strongly compressed. Cleft of mouth deep. Eyes lateral and rather large. Teeth in the jaws and palatine bones, some in the premaxillaries and mandibles being enlarged and barbed. A single long dorsal fin extending from the occiput along almost the entire length of the back. Caudal distinct and forked. Ventrals in the form of a pair of scales. Pectoral with the lower rays the longest. Anal spines numerous, and concealed beneath the skin, the last few enlarged, connected by a membrane, and forming a fin which is continued to opposite the end of the dorsal. Scales absent. Lateral-line median. Air-bladder present. Pyloric appendages many.

The genus obtained the designation of *Lepidopus*, or "scaly-foot," owing to the ventral fins being replaced by a pair of scales.

Geographical distribution.—This abyssal form exists in the Mediterranean, also in the Atlantic from the British shores as far as the Cape of Good Hope, as well as along the coasts of New Zealand and Tasmania. A species, *L. tenuis*, from Japan has likewise been described.

1. Lepidopus caudatus, Plate LI, fig. 2.

Lepidopus, Gouan, Hist. Poiss. p. 185, pl. l, f. 4; Bowdich, Exc. p. 10, f. 1: *Four-toothed Scabbard-Fish*, Pennant, Brit. Zool. (Ed. 2, 1812), iii, p. 210.

Lepidopus argenteus, Bonn. Ency. Ich. 1788, p. 58, pl. lxxxvii, fig. 364 (not Linn.). Nardo, J. Phys. Pav. vii, p. 227; Moreau, Poiss. France. ii, p. 544, c. fig.

Trichiurus caudatus, Euphr. Stockh. K. Vet. Acad. Nya. Handl. 1788, ix. p. 48, t. ix, f. 2; Walb. Artedi, iii, p. 607.

Lepidopus Gouani, Bl. Schn. p. 239, t. liii, f. 2.

Lepidopus Gouanianus, Risso, Ich. Nice, p. 151, and Eur. Mérid. iii, p. 290.

Trichiurus gladius, Holten, Kjöbenh. Skr. Af. Nat. Selsk. 1802, v. p. 23, t. ii, f. 1.

Vandellius Lusitanicus, Shaw, Gen. Zool. 1803, iv. p. 199.

Lepidopus Lusitanicus, Leach, Zool. Misc. ii, p. 7, pl. lxii.

Ziphotheca tetradens, Montagu, Wern. Mem. i, pp 82,623, t. ii and iii, and ii, p. 432.

? Trichiurus lepturus, Hoy, Journal Linn. Soc. xi, p. 210.

Scarcina argyrea, Rafin. Caratt, p. 20, t. vii, f. 1.

Lepidopus Peronii, Risso, Ich. Nice, p. 148, t. v, f. 18, and Eur. Mérid. iii, p. 291.

Lepidopus argyreus, Cuv. Règne Anim. pl. lxvii; Cuv. and Val. viii, p. 223, pl. ccxxiii; Jenyns, Manual, p, 371; Yarrell, Brit. Fish (Ed. 1) i, p. 176, c. fig. (Ed. 2) i, p. 198, (Ed. 3) ii, p. 269; Lowe, Trans. Zool. Soc. ii, p. 181; Guichen. Explor. Algér. Poiss. p. 59; Cocks, Roy. Cornw. Pol. Soc. 1869, p. 68; Ball, Dublin, N. H. Rev. ii, p. 45.

Lepidopus ensiformis, Bonap. Catal. No. 710; Swainson, Fish. ii, p. 254.

Lepidopus tetradens, Flem. Brit. An. p. 205.

Lepidopus caudatus, White, Catal. Brit. Fish. p, 32; Günther, Catal. ii. p. 345; Gill, Pro. Acad. Nat. Sc. Phil. 1863, p. 227; Robson, Tr. N. Z. Inst. viii, p. 218; Allport, Pr. Roy. Soc. Tasm. 1875, p. 86; Steind. Ich. Span. u. Port. 1867, p. 101; Giglioli, Cat. Pesci Ital. p. 24.

Scabbard fish, Couch, Fish. Brit. Isles, ii, p. 59, pl. lxxvii.

B. viii, D. 100-105, A. 18-25, C. 16-18, Cœc. pyl. 23, Vert. 41/71.

Length of head 7, of caudal fin 21 to 24, height of body 15½ to 18 in the total length. *Eye*—circular, diameter 5 to 5½ in the length of the head, 2¼ diameters from the end of the snout. Lower jaw prominent, the maxilla reaches to beneath the front edge of the eye. Some smooth ridges exist along the upper surface of the head. *Teeth*—jaws furnished with a single row of about 20 to 22 small and compressed teeth, internal to which there are anteriorly in the upper jaw, 2 or 3 large, with as a rule, barbed fangs, and another in the lower jaw; a few fine ones on the palatines; tongue smooth. *Fins*—the dorsal commences over the posterior half of the opercle, and is continued along the back almost as far as the base of the

caudal fin, it is of much the same height throughout, being nowhere more than 1/3 of that of the body, its rays are simple, unarticulated, and but little flexible. Pectoral situated in the lower third of the depth of the body, its lower rays the longest, and equal to half the length of the head. Ventral in the form of a pair of scales situated below the middle of the pectoral. Anal fin in the form of minute spines more or less visible, and which become distinct rays in the last portion of its extent, but do not extend so far as the base of the caudal fin, the latter being deeply forked. Only the rays of the pectoral and caudal fin are branched. *Lateral-line*—at first forms a slight arch reaching the middle of the body just beyond the middle of the pectoral fin and is so continued to the centre of the base of the caudal. Anus situated at about the centre of the length of the body and having a small movable scale a little distance behind it. *Colours*—sides and abdomen like burnished silver; fins of a light gray dashed with yellow.

Varieties.—Risso considered that a second form existed with a larger head, 42 rays in the anal fin and a black spot at the anterior portion of the dorsal which had 100 rays, the adults do not exceed 15 inches in length; that it approaches the shore in January and March, while its flesh is soft and but little esteemed. Rafinesque also remarks on a smaller species as existing in Sicily, and which he terms *Scarcina punctata.*

Bonnaterre while figuring *Lepidopus argenteus*, Linn., refers in the text to *Lepturus argenteus*, Linn. Mus. Ad. Frid. 1754, p. 76, pl. xxvi, fig. 2, which is a *Trichiurus.*

Names.—Scabbard fish; scale-foot. Jarretière, French.

Habits.—Montagu's first specimen was said to have been seen swimming with great velocity, its head being above the surface of the water; it was killed by a blow from an oar. Other observers have confirmed the statement as to its rapidity of movement. Valenciennes remarked that in April and May it approaches the shores, but that it generally lives at great depths and is not gregarious, probably only leaving its usual habitat under some exceptional circumstance. It appears to be very voracious, and Dr. Moreau took six fishes from the stomach of one of small size, and it could contain no more, the last one being still at the commencement of the œsophagus.

It is termed *Hiku* or "Frost-fish" in New Zealand, where Mr. Robson states that it comes on shore deliberately, and not in pursuit of prey or to rid itself of a parasite.

Breeding.—In the spring in the Mediterranean.

Diseases.—It appears to be much tormented by internal parasites.

Habitat.—This fish appears to have been first described by Professor Gouan, of Montpellier, in 1770. It is found through the seas of Central and Eastern Europe, not being uncommon in certain parts of the Mediterranean, as Nice, and along the east coast of Sicily, from Messina to the Gulf of Catania, where it is taken from May until September. Wanderers also have occurred along the south coast of Great Britain, while it becomes more frequent through the warmer portions of the Atlantic, and though in diminished numbers, is found so far as the Cape of Good Hope. It has been recorded from New Zealand and Tasmania.

The first British specimen was captured in the summer of 1787 at Dawlish, and notes and drawings of it were taken by Mr. T. Wallcott. The next was 5½ feet long, obtained June 4th, 1808, in Salcombe Harbour, Devonshire. Another at Shapton Bay in February, 1810, and is still in the British Museum, being only 10 inches in length, it gave rise to the supposition that it had been bred not far off. Two were taken in Mount's Bay, one of which was sent to the Linnean Society, the other to the Penzance Natural History Society. Mr. Lukis informed Yarrell of one taken in Guernsey early in 1818. Cocks, l. c., remarks upon a specimen 53½ inches long taken at Gwyllyn Vase, being in the possession of Dr. Bullmore in 1869. Couch stated that he possessed records of four taken in Cornwall, one of which he figured; it was 64 inches long, and was captured twenty miles from land.

One recorded from Ireland (Couch) may refer to a specimen of *Trichiurus* (see p. 155). Ball recorded one from Dublin Bay. It attains to 6 feet in length. The one figured is from a specimen in the British Museum.

Sixth Group—Acanthopterygii Gobiiformes.

No osseous articulation between the suborbital ring of bones and the angle of the preopercle. A single rayed dorsal fin sometimes divided into two parts, the anterior portion of which is composed of spines, which are fewer in number than the rays: soft dorsal and anal generally of equal extent. Ventrals, when present, thoracic or jugular and composed of one spine, and four or five rays. A prominent anal papilla.

Family, XVII—GOBIIDÆ, *Cuvier.*

Pseudobranchiæ present, but sometimes rudimentary. Gill openings varying from extremely narrow to wide, the gill-membranes attached to the isthmus: four gills. Body generally elongated. Eyes lateral, occasionally prominent, and mostly without free orbital margins, the skin being continued directly over their surface. No osseous articulation between the suborbital ring of bones and the angle of the preopercle. Teeth of varying characters, mostly small: canines present or absent. A single rayed dorsal fin sometimes divided into two portions, the spines flexible and less in number than the rays: anal similar to the soft dorsal. Ventrals sometimes united so as to form a disc, or else they arise close together. Scales and lateral line present or absent. Air-bladder mostly absent.* Pyloric appendages, when present, few.

This family has been much subdivided by different authors, owing to the great variations observable among the species composing it. An account, however, of these appears hardly necessary in a work relating solely to the British forms. The majority are littoral fishes, the species composing which often appear to have an extensive range.

The number of British genera which compose the family may be restricted to three.

1. *Gobius.* Two dorsal fins: teeth in the upper jaw in several rows of pointed ones: body scaled.
2. *Aphia.* Two dorsal fins: teeth in the upper jaw in a single series of long ones: posterior to which are two groups of canines: body scaled.
3. *Crystallogobius.* Two dorsal fins: teeth conical and fixed: body scaleless.

Genus I—Gobius,† *Artedi.*

Cryptocentrus, Ehr.: *Awaous*, Val.: *Chœturichthys*, Rich.: *Cephalogobius*, *Platygobius*, *Brachygobius*, *Hypogymnogobius*, *Callogobius*, *Stenogobius*, *Actinogobius*, *Hemigobius*, *Ctenogobius*, *Centrogobius*, *Acentrogobius*, *Porogobius*, *Amblygobius*, *Odontogobius*, *Pargobius*, *Zonogobius*, *Stigmatogobius*, *Oxyurichthys*, *Amblychœturichthys*, *Parachœturichthys*, Bleeker: *Gallichthys*, Cope: *Glossogobius*, *Pomatoschistus*, *Acanthogobius*, *Eucyclogobius*, *Lepidogobius*, *Rhinogobius*, *Synechogobius*, *Gobionellus*, Gill: *Gillia*, Günther: *Gobiopsis*, *Cyclogobius*, *Oplopomus*, Steind.: *Chonephorus*, *Samaragdus*, Poey: *Gobiichthys*, Klunz.

* Urinary bladder generally large.

† For the definitions of each of the various named subdivisions of the genus *Gobius* see my Fishes of India, p. 282.

Branchiostegals five: pseudobranchiæ present. Gill-openings of moderate width. Body low and elongated. Opercles unarmed. Simple teeth in one or more rows in the upper, and two or more in the lower jaw: canines sometimes present. Anterior portion of the dorsal fin with from five to six flexible spines, the soft portion of the fin being more developed than the spinous, and of the same character as the anal: ventrals united, forming a disc attached only by its base, each fin consisting of one spine and three or four rays. Caudal rounded or wedge-shaped. Scales present, and either cycloid or ctenoid. Lateral-line absent. Air-bladder, if present, mostly small. Pyloric appendages as a rule absent.*

Naturalists have described gobies as being very tenacious of life, a conclusion not in accordance with my experience. *E. J. S.* observes of some kept in an aquarium, that after he had had them some little time they began to breed, and attached their eggs to the side of the glass, in the same kind of way in which a caterpillar affixes its eggs to a leaf. These the male goby at once set to guard, and it was very amusing to watch how fiercely he would attack any creature coming near, puffing his cheeks out in a curious manner. He constantly attached himself by his ventral fins close to the eggs or kept swimming near them. Unfortunately none were hatched (Hardwicke, Science Gossip, 1865, p. 42). Mr. A. Walker, of Chester, has kindly sent me the following interesting information. "There is one species (? *G. Ruthensparri*) that is common in the shallow gutters of the Dee, whose habits are worth noting. It lays its eggs in the inside of an empty valve of *Mya arenaria*, one end of which it then contrives to bury in the sand, leaving the other end (in which the eggs are laid) sticking up. The goby then places herself inside, with her head looking out, and thus keeps guard over her eggs and protects them from the crustacea, such as shrimps and *Eurydice pulchra* (a small but voracious Isopod, extremely common in the Dee). If the shell is turned over and the fish driven away, these crustacea attack the ova at once, but as soon as the parent is permitted, she returns, drives them away, and by burrowing with her head under one end of the shell, soon gets it into its place again" (MSS. March 2nd, 1881). It has been frequently asserted that gobies construct nests wherein to deposit their eggs, and some of these statements have arisen after seeing how the stickleback behaves: Dr. Ninni (Alti Soc. Pad. i, 1872, pp. 92-96), gives a list of twelve species of fishes which breed in the Lagunes of Venice, and observes that four species of gobies and the stickleback build nests.

The fishes comprising this genus have the form of the body variously modified, some being much deeper than others. Occasionally the head is scaleless and the body even partially so. Barbels or warts on the head, or an occipital crest may be present or absent. The dentition is subject to considerable modifications, canine teeth being present or absent, and when present being most commonly in the form of a recurved one on the outer side of the enlarged lateral row in the lower jaw: but variations may occur in specimens belonging to the same species. In some the two dorsals are almost united at their bases, in others there exists an interspace between them, but the form of the fins, the character of the spines, the number of rays and the colours are subject to considerable variation. As these fishes decompose rather readily, care has to be taken that the spirit in which they are preserved is of sufficient strength.

It must be observed that a very great latitude exists both in the colours and modes of marking of the European gobies which has given rise to some confusion in the literature of the various species. Likewise, should they "die hard," their gill-covers and head become distended, in which position they stiffen as has been remarked upon under the head of the *Serrani*, p. 15.

Among the British Gobies are some doubtful species, and I must here point out that although in the Catalogue of the British Museum, Volume i, page iv of the preface, it is observed that "the collection contains many typical specimens, as there has been embodied with it, besides other minor collections, * * * The collection of the fishes of the Firth of Forth and Scottish rivers by Dr. Parnell." This statement might occasion the belief that the entire collection of

* Dr. Moreau observes that *Gobius quadrimaculatus* has only four.

that Ichthyologist had been obtained by the National Museum. At Edinburgh, however, I was informed this was an error, and Dr. Traquair, F.R.S., showed me some of Parnell's types. In the Wernerian Memoirs, Vol. vii, 1838, p. 498, is the following resolution: "That the honorary premium of ten sovereigns or a piece of plate of that value, should be awarded to Dr. Richard Parnell, upon a selection from the dried specimens submitted to the Society on 30th April last, and containing such species as are mentioned by the author as new to the district, or which may be considered in any way doubtful, being presented to the Museum of the Society."

In the proceedings of the Royal Society of Edinburgh i, 1844-1850, p. 164, a list of seventy-eight species received from Dr. Parnell is enumerated, among these were the following gobies in spirit. *Gobius niger*, Yarrell: *G. minutus*, Yarrell: *G. unipunctatus*, Parnell: *G. bipunctatus*, Yarrell and *G. albus*, Parnell. Consequently all Parnell's types were not in the collection obtained for London.

Synopsis of British Species of Gobius.*

A. *First dorsal fin with seven spines.*

1. *Gobius Ruthensparri*, D. $7/\frac{1}{10}$, A. $\frac{1}{10\text{-}11}$, L. l. 35-40,† L. tr. 11. Dorsal fins rather wide asunder. One black spot in the pectoral region, a second at the base of the tail fin.

B. *First dorsal fin with six spines.*

2. *Gobius paganellus*, D. $6/\frac{1}{14\text{-}16}$, A. $\frac{1}{13\text{-}14}$ L. l. 56-58, L. tr. 15-16. Dorsal fins close together, the first being rather low. Nearly black, fins mostly with light edges.

3. *Gobius niger*, D. $6 \mid \frac{1}{12\text{-}13}$, A. $\frac{1}{10\text{-}12}$, L. l. 39-41, L. tr. 12-13. Dorsal fins close together. Light brown, variously marked with darker.

4. *Gobius minutus*, D. $6 \mid \frac{1}{10\text{-}11}$, A. $\frac{1}{10\text{-}12}$, L. l. 60-70, L. tr. 12-14. Dorsal fins rather wide asunder. Sandy coloured, with darker markings and spots.

5. *Gobius Parnelli*, D. $6 \mid \frac{1}{9\text{-}10}$, A. $\frac{1}{9\text{-}10}$, L. tr. 40, L. tr. 11. Dorsal fins close together. Slate coloured, with dark vertical bands: fins black, with white horizontal lines. A black spot at end of first dorsal, another at base of caudal fin.

6. *Gobius pictus*, D. 6/10, A. 9, L. l. 35-40, L. tr. 10-11. Dorsal fins close together. Light, with darker irregular bands: dorsal fins with three or more rows of large round spots.

7. *Gobius quadrimaculatus*, D. $6/\frac{1}{9\text{-}10}$, A. $\frac{1}{9\text{-}10}$, L. l. 37-40, L. tr. 7-8. Dorsal fins close together: second spine of first dorsal frequently elongated.

A. *First dorsal fin with seven spines.*

1. Gobius Ruthensparri, Plate LII, fig. 1.

Gobius ruthensparri, Euphr. Nya Handl. Stockh. 1786, p. 64, t. iii, f. 1; Retz. Faun. Suec. p. 326; Thompson, Nat. Hist. Ireland, iv, p. 115; Fries, Wiegm. Arch. 1840, p. 237; Cuv. and Val. xii, p. 48; Yarrell, Brit. Fishes (Ed. 2) i, p. 285 (Ed. 3) ii, p. 322; Kröyer, Dan. Fis. i, p. 399, c. fig.; Nilss. Skand. Faun. iv, p. 226; White, Catal. Brit. Fish, p. 52; Günther, Catal. iii, p. 76; McIntosh, Fish, St. Andrews, p. 174; Collett, Norges Fis. p. 58; Heinke, Arch. Nat. 1880, p. 310; Moreau, Poissons France, ii, p. 232; Giglioli, Pesci Italiani, p. 29.

Gobius flavescens, Fabr. Reise n. Norw. p. 322.

Gobius minutus, Nilss. Prod. p. 94.

* Dr. Günther, Intr. Study of Fish, p. 486, includes *Gobius auratus* among the British forms. In the Catal. Fish. Brit. Mus. iii, p. 11, he gives as the habitat of this fish, "coast of Nice." A variety of *G. niger* he observes is "perhaps identical with *G. auratus*, Risso." Couch's fish I believe to be one of our common species. Thus unable to ascertain why *G. auratus*, unless as a variety of *G. niger*, has been considered British, I have omitted it.

† By Lateral-line is meant the number of rows of scales between the head and the base of the caudal fin.

Gobius niger, Donov. Brit. Fish. pl. civ.; Fleming, Brit. Vert. p. 206.

Gobius bipunctatus, Yarrell, Brit. Fishes (Ed. 1) i, p. 255; Jenyns, Manual, p. 386; Parnell, Fishes Firth of Forth, p. 86, pl. xxix, and Wern. Mem. vii, p. 246, pl. xxix; Johnston, Berwick. Field Club, 1838, i, p. 172; McIntosh, Fish. North Uist. P. R. S. Edin. v, 1862-66, p. 614; Collett, Norges Fis. p. 58; Winther, Ich. Dan. Mar. 1879, p. 17.

Two-spotted goby, Couch, Fish. Brit. Isles, ii, p. 162, pl. c, fig. 3.

Gobius biocellatus, or *broad-finned goby*, Couch, l. c. p. 165, pl. ci, f. 1 (not Cuv. and Val.).

Gobius pusillus, Lowe, Fauna of Norfolk, Fishes p. 12 (not Canestrini).

B. v, D. $7/\frac{1}{10\text{-}11}$, P. 19, V. 1/5, A. $\frac{1}{10\text{-}11}$, C. 15, L. l. 34-40, L. tr. 11.

Length of head $4\frac{1}{4}$, of caudal fin 5 to $5\frac{1}{2}$, height of body 6 in the total length. *Eyes*—high up, separated by a very narrow interorbital space, diameter $3\frac{1}{4}$ in the length of the head, 3/4 of a diameter from the end of the snout and also apart. Head as high as wide: snout obtuse. Cleft of mouth oblique, commencing opposite the upper third of the orbit, lower jaw prominent: the maxilla reaches posteriorly to beneath the first third or middle of the orbit, no perceptible rows of warts on the head. *Teeth*—several rows of pointed ones in both jaws, the outer row in the fore portion of the mandibles being considerably the largest and slightly curved. *Fins*—the dorsals placed rather far asunder, the extent of the interspace being equal to nearly half the length of the base of the first dorsal, the longest spines of which latter fin are nearly equal to the height of the body below it, and also to the rays of the second dorsal: the length of the caudal pedicle equals that of the head so far as the hind edge of the preopercle. Pectoral, without any of its upper rays being silk-like, reaches as far as to above the end of the ventrals, which latter do not extend to so far as the anus. Caudal cut almost square. *Scales*—angular in their exposed portion and strongly ctenoid: 11 rows between the origins of the second dorsal and anal fins: anterior to the first dorsal fin they are absent, while there are none on the cheeks or gill covers. *Colours*—body of a cinnamon colour, becoming light beneath: the darker tinge of the back descending in a wavy or irregular manner on the sides. A black spot on the side opposite the outer half of the pectoral fin, and a second at the base of the caudal. Fins pale, with two rows of light coloured spots along either dorsal, wavy vertical bands on the caudal, and a light edge having a darker base along the anal. A dark band from the eye to the corner of the mouth.

The dark spot behind or above the middle of the pectoral fin is sometimes absent, while it seems to be frequently lost in specimens which have been kept long in spirit. Yarrell's variety of *G. unipunctatus*, with seven dorsal spines (Ed. 3, page 239), was probably *G. Ruthensparri*.

Mr. A. Roberts, curator of the Scarborough Museum, observed that the female is fully one-third longer than the male, and has only one spot at the base of the caudal fin, whereas the male has two. For several years he bred these fishes in confinement, and thus possessed opportunities for watching them.

Couch considered his *G. biocellatus* to differ from *G. Ruthensparri*, more especially in the greater elevation of the second dorsal fin. Dr. Lowe, l. c. described his *G. pusillus*, which he has since ascertained has six or seven spines in the first dorsal fin, and of which he has been so good as to send me a figure.

Name.—Double-spotted goby, due to its colours.

Habits.—Prefers rocky situations, and does not appear to frequent sandy localities. According to Parnell, it keeps but a short distance from below the surface of the water, apparently in a motionless position, assuming in this respect much the habits of the stickleback: when approached, it gradually lowers itself into the deep and soon disappears, by making short though rapid darts among the *fuci*, which it delights to frequent. Dr. Lowe observes of *G. pusillus*, that "when transferred to an aquarium, from the pool in which they were discovered, they lived for a long time in quite fresh water if gradually accustomed to it, but when suddenly placed in cold fresh water they were apparently asphyxiated, all the fins becoming rigidly expanded. They took food readily from the hand,

and would attach themselves to the sides of the glass in any position by means of the ventral fins.

Breeding.—Mr. Roberts, observed that when the female had deposited her eggs in the shell of a barnacle, the male took possession of the deposit, and was continually working his fins in and out of the shell and drove other fish away. On the sixteenth day the young fish were hatched, but were destroyed by the other fish in the vivarium.

Uses.—Due to their small size, more as the food for other fishes or birds than man. They are frequently taken from the stomach of the cod and haddock, and Yarrell records one from the inside of a tern.

Habitat.—Seas of Northern Europe excluding the Baltic, and not recorded along the Mediterranean coast of France. Although it has been said by Nardo to exist in the Adriatic, Canestrini and others have not obtained it there. It is found off Norway and Denmark: is not infrequent in the Orkneys and Shetland Isles, and extends round the coast of Great Britain, being very common in suitable places: in Cornwall it is said to be rather rare, but becomes numerous off the Channel Islands, and west coast of France.

In Ireland it is common on the north-east coast, especially along the shores of Down, and is also abundant on the western coast, certainly as far as the Island of Arran.

It attains to at least 2½ inches in length. The example figured, and for which I am indebted to Mr. J. Carrington, F.L.S., was obtained in Guernsey with several others.

B. *First dorsal fin with six spines.*

2. Gobius paganellus, Plate LII, fig. 2.

Paganellus Venetorum, Willugh. p. 207; Ray, p. 75. *Gobius*, sp. 2, Artedi, Genera, p. 29; Hasselq. Reise nach Palæst. p. 373.

? *Gobius melanio*, Pallas, Zoo. iii, p. 157; Rathke, Faun. der Krym, p. 327; Nord. Demid. Voy. Russ. Mérid. iii, p. 412, Poiss. pl. xi, fig. 1; Kessler, Bull. Soc. Nat. Mosc. 1859, ii, p. 250.

Gobius bicolor, Brunn. Pisc. Mass. p. 30, no. 41; Gmel. Linn. p. 1197; Cuv. and Val. xii, p. 19; Moreau, Poiss. France, ii, p. 228.

Gobius paganellus, Gmel. Linn. p. 1198; Cuv. and Val. xii, p. 20; Günther, Catal. iii, p. 52; Andrews, Journ. Roy. Dublin Soc. v, 1866-70, p. 381; Steind. Ich. Span. u. Port. 1868, p. 63.

Gobius niger, Risso, Ich. Nice, p. 158 and Eur. Mérid. iii, p. 280; Yarrell, Brit. Fishes, (Ed. 2) i, p. 281 (Ed. 3) ii, p. 318 (in part); Thompson, Nat. Hist. Ireland, iv, p. 111; Canestr. Arch. Zool. i, p. 135, t. vii, f. 2.

Gobius punctipinnis, Canestrini, l. c. p. 131, t. x, f. 1.

Gobius maderensis, Cuv. and Val. xii, p. 55 (var.); Günther, Catal. iii, p. 57.

Gobius niger, var. Lowe, Proc. Zool. Soc. 1839, p. 84 and Trans. iii, p. 10.

Paganellus, Couch, Fish. Brit. Isles, ii, p. 157, pl. xcviii.

B. v, D. $6/\frac{1}{14\text{-}16}$, P. 20, V. 1/5, A. $\frac{1}{12\text{-}14}$, C. 13, L. l. 54-58, L. tr. 15-17.

Length of head 4 to 4¼, of caudal fin 5½ to 6, height of body 5¼ to 6 in the total length. *Eye*—rather prominent, diameter 1/4 of the length of the head, about 1 diameter from the end of the snout, and 1/3 to 1/2 a diameter apart. Head depressed, broader that high: cheek swollen and during life no deep groove extending from the base of the first dorsal fin to the occiput: cleft of mouth oblique commencing opposite the upper third of the eye. Mouth rounded, jaws of about the same length anteriorly, or the lower slightly the longer. The maxilla reaches to beneath the first quarter of the eye: lips thick and with a fringed row of barbel-like papillæ. Several rows of warts descending from the eye to the cheeks, and more especially towards the angle of the mouth. *Teeth*—pointed, no canines, the outer row in either jaw considerably enlarged and somewhat curved, especially in the upper jaw. *Fins*—the dorsal fins placed close together, the spines of the first weak, and from half to two-thirds the height of the body beneath, but not so high as the rays of the second dorsal. The distance between

the eye and the first dorsal fin is equal to that between the end of the snout and the angle of the preopercle. Pectoral as long as the head excluding the snout: its upper 6 or 7 rays silk-like. Ventrals short, extending 2/3 of the distance to the vent. Caudal rounded. An anal papilla present. *Scales*—except in the anterior portion of the body, ctenoid, 15 to 17 rows between the origin of the second dorsal and anal fins. Some scales on the upper portion of the opercle, the remainder of the head scaleless, while superiorly some extend as far forward as the eyes: about 35 rows anterior to the base of the dorsal fin. *Colours*—the body is nearly black, becoming lighter on the sides and beneath. The first dorsal fin is dark with a light or orange outer edge, the lower two-thirds is mostly horizontally banded, the lowest band terminating in a black spot behind the last spine. Second dorsal and anal nearly black, with spots or blotches and a light or orange outer edge. The other fins dark.

In one male example among several from Weymouth, collected by the late Professor Rolleston, F.R.S., the colours are much lighter than described above being more similar to what obtains in *G. niger* and agreeing with *G. paganellus* C. V. The specimen is of a light brown or gray irregularly marked with darker, and somewhat band-shaped descending bars on the posterior portion of the body. Upper border of the first dorsal fin with an orange band, the rest of the fin with irregular brownish horizontal bands: second dorsal spotted with brown or light marks: pectoral with three or four band-like rows of spots: it, the caudal and anal darkest externally. Ventral gray or gray with a light outer edge. A small dark spot at the upper part of the base of the caudal fin: and a light spot with a dark brown edge at the upper portion of the base of the pectoral fin. This can scarcely be Moreau's fish, with D. $6/\frac{1}{12\text{-}13}$, A. $\frac{1}{10\text{-}12}$, L. l. 44-48, L. tr. 15.

This species is of a much stouter shape than *G. niger*

Habits.—Does not appear to be so restricted to rocky localities as *G. niger*, but its habits have still to be investigated. It is found under rocks at low tides in Mounts Bay, Cornwall.

Breeding.—In May or June.

Habitat.—This species having been so mixed up with *G. niger*, it is difficult to give an opinion respecting which the various authors allude to. It has been recorded from Tory Island off Donegal and Galway (Thompson), also from Kenmare Bay (Andrews, Journ. Roy. Dub. Soc. v, 1866-70, p. 381), Cork (Thompson), and Clonakilty (Leach) in Ireland. Firth of Forth in Scotland, and especially along the south coast of England to Mounts Bay, and St. Ives: the English Channel, Bay of Biscay, and as far south as Madeira, also the Mediterranean.

The example figured, life size, is a male taken on the coast of Sussex; the ventral fins are rather short in comparison with some other examples. The fish attains to at least 4 inches in length.

3. **Gobius niger,** Plate LII, fig. 3.

Gobio niger, Rondel. 17, c. 17, p. 200; Gesner, p. 385; ? Schonov. p. 36; Willughby, p. 206, t. N 12, f. 1; Ray, p. 76. *Gobius*, No. 1, Artedi, Genera, p. 28. *Black Goby*, Pennant, Brit. Zool. (Ed. 1) ii, p. 203, pl. xxxviii (Ed. 2) iii, p. 288, pl. xlii; Low, Fauna Orcadensis, p. 205.

Gobius niger, Linn. Syst. Nat. i, p. 449; Retz. Faun. Suec. p. 326; Bloch, t. xxxviii, f. 2, 3, 4, 5; Shaw, Brit. Zool. iv, p. 232, pl. xxxiv, f. 2; Müll. Prod. Zool. Dan. p. 44; Turton, Brit. Fauna, p. 94; Nilss. Prod. Zool. Suec. p. 93, and Skand. Fauna, iv, p. 219; Jenyns, Manual, p. 385; Thompson, Proc. Zool. Soc. 1835, p. 80, and Nat. Hist. Ireland, iv, p. 111; Ekstr. Fische Mörkö, p. 255; Fries och Ekström, Skand. Fisk. p. 157, t. xxxvi; Yarrell, Brit. Fishes (Ed. 1) i, p. 251, c. fig. (Ed. 2) i, p. 281 (Ed. 3) ii, p. 318; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 410; Kröyer, Dan. Fiske, i, p. 382, c. fig.; Cuv. and Val. xii, p. 9; Parnell, Fishes Firth of Forth, p. 81, pl. xxix, and Werñ. Mem. vii, p. 240, pl. xxix, f. 1; Fries, Wiegm. Arch. 1840, p. 237; Günther, Catal. iii, p. 11; McIntosh, Fish. St. Andrew's, p. 174; Collett, Norges Fis. p. 52; F. Heincke, Arch. Nat. 1880, p. 306; Winther, Ich. Dan. Mar. 1879, p. 16; Moreau, Poiss. France, ii, p. 230 (L. tr. 15-16).

Gobius jozo, Bloch, t. cvii, f. 3.

Gobius fuliginosus, McCoy, Ann. and Mag. Nat. Hist. 1841, vi, p. 403.

Gobius Britannicus, Thompson, Proc. Zool. Soc. 1837, p. 61, and Nat. Hist. Ireland, iv, p. 111.

? Gobius paganellus, Moreau, l. c. ii, p. 225.

Rock Goby, Couch, Fish. Brit. Isles, ii, p. 153, pl. xcviii.

B. v, D. 6 | $\frac{1}{12\text{-}13}$, P. 18, V. 1/5, A. $\frac{1}{10\text{-}12}$, C. 13, L. l. 39-41, L. tr. 12-13.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin $5\frac{1}{4}$ to $5\frac{2}{3}$, height of body 6 to $6\frac{1}{2}$ in the total length. *Eye*—prominent during life, diameter $3\frac{1}{2}$ to 4 in the length of the head, 3/4 to 1 diameter from the end of the snout, and separated by a very narrow interspace. Head rather broader than high, snout obtuse. Cleft of mouth moderately oblique, the jaws anteriorly being of nearly equal length, the maxilla reaching to beneath the anterior edge of the orbit, a deep sulcus goes from the base of the first dorsal fin to the occiput. Several short rows of warts descend from the orbit over the opercles, there are likewise occasionally some similar but horizontal rows, the most visible of which commences at the angle of the mouth. *Teeth*—several rows of pointed ones in either jaw, the outer of which are larger and more curved than the remainder. *Fins*—dorsal fins placed close together, but their bases do not quite join, the spines of the first dorsal weak, elongated, and as high as or higher than the body: second dorsal about as high as the body, with its last ray divided to its base. Pectoral, usually a few of its upper rays silk-like, it reaches to above or even behind the anal papilla. The ventrals as a rule extend to the anus. Caudal wedge-shaped, its central rays being the longest. *Scales*—angular in their exposed portion and ctenoid: 12 or 13 rows between the origins of the second dorsal and anal fins, anterior to the first dorsal fin they are very small and rounded, but continued as far forward as opposite the hind margin of the orbit. None on the cheeks or gill-covers. *Colours*—subject to considerable variation, being more or less of a dull brown, having a wide but badly marked lateral band, and various blotches or marblings. The fins in the young are light, covered with black spots, except the ventrals which are unspotted: whereas in adults the spots become more expanded, and light sinuous lines are frequently seen on the dorsals, while a black spot usually exists between the two first dorsal spines. In adults the ventrals may be either light coloured or dark with a light outer edge. A black spot is frequently present at the upper portion of the base of the pectoral fin: caudal barred in spots.

Varieties.—Nilsson states that the pectoral and ventral fins are shorter in the female than in the male, and the two dorsal fins somewhat farther asunder. There is a British example in the National Museum having the outer row of teeth in the upper jaw slightly enlarged, and which it has been suggested may be identical with *Gobius auratus*, Risso. Moreau, gives the number of lateral transverse rows of scales at 15 to 16.

Names.—*Sea-gudgeon* and *rock-fish*, due to their living in rocky localities or attaching themselves to rocks by means of their ventral fins, a faculty denied to them by Fleming. *Groundling*. Cornish observes that in Cornwall it is sometimes termed *Miller's thumb* (see pp. 46, 48, *ante*). *Cabot*, French.

Habits.—Resides in the neighbourhood of rocks, and Couch has observed that having carried off its prey in its mouth, as does the shanny, it subsequently struggles with it. This goby is occasionally found in rock pools situated above the reach of any but very high tides. When detected, it darts away from its place of concealment to some more secure retreat, while its colour aids in preventing its being seen. Its food appears to be small fishes, crustaceans and other animal substances, but ore-weed has also been taken from its stomach. Couch mentions having taken a shanny 2 inches long from the inside of a rock-goby which but little exceeded 6 inches in length. He likewise remarks that this fish is equally capable of living in fresh or salt water, even if changed suddenly from one to the other.

Breeding.—About June.

As food.—Said to be good by those who have tried it, but its size renders it of little use for this purpose except for large fish and aquatic birds.

Habitat.—From the Baltic (where it is of small size) and coasts of Scandinavia to the Orkneys, Great Britain and Ireland, also the British Channel, as well as the Atlantic and Mediterranean coasts of Europe.

In the Orkneys it is pretty frequent according to some observers, but W. Baikie says it is rare; while at Weymouth and along the south and south-west coasts of England it is abundant in tidal pools. In short, as observed by Jenyns, it is found on many parts of the coast, but not in any abundance.

It attains to at least $9\frac{1}{2}$ inches in length, and is the largest of the British species of this genus. The example figured was from Weymouth.

4. Gobius minutus, Plate LII, fig. 4.

Aphya, Rondel. vii, c. 3, p. 210. *Aphya cobitis*, Willughby, p. 207, pl. xii, f. 5. *Marsio*, Ray, p. 76. *Gobius*, sp. Artedi, Genera, p. 29, and sp. 4 Synon. p. 47. *Gobius*, No. 276, Gronov. Zooph. i, p. 81. *Spotted Goby*, Pennant, Brit. Zool. (Ed. 1) iii, p. 215, pl. xxxvii. (Ed. 2) iii, p. 187, t. xli. Duhamel, Pêches, pt. ii, sec. 6, pl. 3, f. 3.

Gobius aphya, Linn. Syst. Nat. i, p. 450 (pt.); Artedi, ed. Walb. iii, p. 192; Bl. Schn. p. 70; Risso, Eur. Mérid, iii, p. 281.

Gobius minutus, Gmel. Linn. p. 1199; Lacépède, ii, p. 571; Donovan, Brit. Fish. ii, pl. xxxviii; Turton, p. 94; Fleming, Brit. An. p. 206; Yarrell, Brit. Fish. (Ed. 1) i, p. 258, c. fig. (Ed. 2) i, p. 288 (Ed. 3) ii, p. 325; Jenyns, Manual, p. 386; Parnell, Fishes Firth of Forth, p. 82, pl. xxix and Wern. Mem. vii, p. 242, pl. xxix (*female*); Cuv. and Val. xii, p. 29; Nilsson, Skan. Faun. iv, p. 222; Ekst. Fische Morkö, p. 260; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 410; Fries, Wiegm. Arch. 1840, p. 237; White, Catal. Brit. Fish. p. 53; Thompson, N. Hist. Ireland, iv, p. 116; Kröyer, Dan. Fish. i, p. 407, c. fig: Guichen. Explor. Algér. Poiss. p. 78; Günther, Catal. iii, p. 58; McIntosh, Fish. N. Uist. Pro. R. Soc. Edin. v, 1862-66, p. 614; Collett, Norges Fis. p. 53; Winther, Ich. Dan. Mar. 1879, p. 17; Giglioli, Pesc. Ital. 1880, p. 29; Canestrini, Arch. Zool. 1861, p. 148, t. ix: Moreau, Poiss. France, ii, p. 212.

Eleotris minuta, Bl. Schn. p. 66.

Gobius gracilis, Jenyns, Brit. Vert. p. 387 (*male*); Yarrell, Brit. Fish. (Ed. 2) i, p. 290, c. fig. (Ed. 3) ii, p. 331; Thompson, Pro. Zool. Soc. 1837, p. 57 and l. c. p. 116; White, Catal. p. 53.

Gobius unipunctatus, Parnell, Fish. Firth of Forth, p. 83, pl. xxix (*male*) and Wern. Mem. vii, p. 243, pl. xxix; Thompson, l. c. p. 117.

Gobius reticulatus, McCoy, Ann. and Mag. Nat. Hist. vi, p. 403.

Gobius rhodopterus and Eckstromii, Günther, Catal. iii, pp. 17, 57.

Yellow goby and *one-spotted goby*, Couch, Fish. Brit. Isles, ii, pp. 159, 167, pl. c. fig. 1 and pl. ci, fig. 3.

Gobius attenuatus, or *tail-spotted goby* (*young*), Couch, l. c. p. 166, pl. ci, fig. 2.

B. v, D. $6/\frac{1}{10-11}$, P. 21, V. 6, A $\frac{1}{10-12}$, C. 11, L. l. 60-70, L. tr. 12-14.

Length of head 4 to $4\frac{1}{2}$, of caudal fin $6\frac{1}{4}$ to $6\frac{2}{3}$, height of body $6\frac{1}{2}$ in female to 8, in the total length. *Eye*—diameter 4 to $4\frac{1}{2}$ in the length of the head, 3/4 to 1 diameter from the end of the snout and superiorly placed close together. The eye in the female in some examples is a little nearer the end of the snout than is that of the male. The greatest width of the head equals (or exceeds in large specimens) its length behind the middle of the eyes, and is about equal to its greatest height in smaller examples. Lower jaw slightly the longer. Cleft of the mouth oblique, the upper jaw reaching to below the first third on even centre of the orbit. Cheeks swollen. No warts on the head except in large examples, when a horizontal row exists across the cheeks, from which several shorter ones descend. Barbels absent. *Teeth*—in several rows in both jaws, the front and an outer series in the mandible being slightly larger than the remainder, none on the palate nor on the tongue. *Fins*—spines of first dorsal flexible but not prolonged, they are lower than the height of the body: there is some considerable interspace,

about equal to two-thirds the length of the base of the first dorsal fin, between the two dorsal fins. Second dorsal as high as the body in the male, but lower in the female. None of the pectoral rays silk-like. The ventral extends to the vent. Caudal somewhat rounded at its extremity. *Female*—in some examples the head is shorter and more square than in the male. *Scales*—ctenoid, extending anteriorly to above the posterior extremity of the preopercle. Those on the last portion of the body a little larger than those anteriorly and more angular in their exposed part. *Colours*—in the *male* of a gingery-brown, with spots and even vertical bands along the side of the body, and usually a dark mark at the base of the caudal fin. Dorsal gray with three or four irregularly longitudinal bands of spots, and a black spot edged with white between the fifth and sixth spines, also a black edging to the membrane going from the sixth spine to the back. Second dorsal with several rows of spots and dark outer edge: pectoral and ventral light coloured. Anal stained externally with black. Caudal with a dark extremity, and five or six irregularly vertical bands of spots. *Female*—lighter than the male: fins light coloured, the first dorsal with two or three horizontal bands and sometimes with a small spot between the fifth and sixth spines. Second dorsal with yellow spots: caudal fin banded with rusty spots. In some examples there are several vertical narrow and usually dark bands on the body.

Varieties.—Parnell considered those examples which possessed a black spot between the fifth and sixth spines of the first dorsal fin, the second dorsal with eleven rays and the tail fin even at its extremity belonged to his *G. unipunctatus*, whereas they would seem to be the typical *G. minutus*. He found this form equally common with what he considered the true *G. minutus*, but which perhaps is *G. microps* of Malm, specimens of which I received from Professor Lütken of Copenhagen; they are differentiated by having no scales on the throat where *G. minutus* is densely covered by them. This well marked form does not appear to attain the size of *G. minutus*, while its markings differ, consisting of a more or less distinct rows of black blotches along the middle of the side and numerous dark sinuous lines along the rows of scales in the upper half of the body. Respecting *G. reticulatus* (c. v.) McCoy, Thompson observes that he has seen *G. minutus* display the rosy tint in the first dorsal fin mentioned by McCoy, and other characters so closely agreeing with the specimen he described that he could not consider them different species.

Names.—*Freckled* or *spotted goby*. *Polewig* or *pollybait*, Thames local name. *One-spotted goby*. *Craigbysg brych*, Welsh. *Donlie* at Aberdeen. *Bourguette* or *Bouhotte*, French.

Habits.—Delights in shallow and sandy bays, and often taken in shrimping nets. It is very active and may be seen darting about in all directions. Templeton observed that it lodges under large shells when the tide is out. As however it is frequently found in the stomach of cod and other fish captured at considerable depths, it would appear that it extends its range into deep water. Its food consists of small crustacea.

Breeding.—In June.

Uses.—Larger ones are sometimes employed as baits.

Means of capture.—These little fishes are commonly taken in small nets by shrimpers, in sandy bays around the coast, and also by dredging, extending as they frequently do to some fathoms depth off the coast. They are numerous at the mouth of the Thames, and commonly found among the whitebait brought to the London market.

Habitat.—From the Scandinavian peninsula to the Orkneys and Shetlands, and along the shores of Great Britain and Ireland in appropriate localities: likewise in the English Channel and the Atlantic and Mediterranean shores of Europe.

Ireland, common in sandy bays from north to south, and Thompson took large ones while dredging in water several fathoms deep, which is not uncommon elsewhere during the summer months.

This fish attains to at least $3\frac{1}{2}$ inches in length, at which size I obtained it at Aberdeen. The example figured is one I took at Weston-super-Mare.

5. Gobius Parnelli, Plate LII, fig. 5.

? Gobius gracilis, Parnell, Fishes Firth of Forth, p. 85, pl. xxix, and Wern. Mem. vii, p. 245, pl. xxix (not Jenyns nor Fries, &c.).

? Gobius unipunctatus, Yarrell, Brit. Fish. (Ed. 3) ii, p. 327.

Gobius auratus, Couch, Fish. Brit. Isles, ii, p. 159, pl. c. f. i (not Risso) *female.*

Gobius minutus, Couch, l. c. ii, p. 161, pl. c. f. 2 (not Gmel. Linn.).

Little and *speckled goby*, Couch, Fish. Brit. Isles, ii, pp. 161, 170, pl. c. fig. 2 and cii, f. 1.

B. v, D. 6 | $\frac{1}{9\text{-}10}$, P. 19, V. 1/5, A. $\frac{1}{9\text{-}10}$, C. 13, L. l. 40, L. tr. 11.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin $5\frac{1}{2}$ to 6, height of body 6 to 7 in the total length. *Eye*—diameter $3\frac{1}{2}$ to 4 in the length of the head, 3/4 to 1 diameter from the end of the snout, and nearly 1/4 of a diameter apart. Interorbital space scaleless, and slightly concave from side to side. Snout somewhat obtuse. Cleft of mouth commencing opposite the upper edge of the eye. Lower jaw the longer, the posterior extremity of the maxilla reaches to beneath the front third of the eye. Head rather broader than high. Cheeks swollen: neither warts nor barbels on the head. *Teeth*—those in the outer row in the lower jaw much larger than the rest: none on vomer, palatines, or tongue. *Fins*—spines of first dorsal flexible and but little prolonged beyond the membrane, the two dorsals of about equal height, and in the male equalling that of the body, but less in the female, the interspace between the two fins is equal to two-thirds of the length of the base of the first dorsal. Ventral fin reaches to the vent, while the pectoral is somewhat shorter, and none of its upper rays are silk-like. Anal commences beneath the second or third dorsal ray, and terminates opposite the end of that fin. Caudal somewhat square. *Scales*—ctenoid, commencing anteriorly just behind the occiput: beneath the middle of the second dorsal their size almost suddenly augments, and are thus continued to the end of the body in the last 15 rows. *Colours*—of a leaden gray, with several vertical black bands on the body: fins black, the dorsals with narrow white horizontal bands: caudal with dark vertical bands.

Whether this is Parnell's fish may be questioned, his type at Edinburgh having been mislaid. That this fish is not *G. minutus* is very evident, as the scales widely differ in number as well as in character.

Habitat.—The coasts of Great Britain.

Parnell observes *G. gracilis* is occasionally found in the Firth of Forth, the Solway Firth, and in much greater plenty on the south coast of England. Lowe observed *G. rhodopterus*, Günther, on the Norfolk estuary, July, 1868, but which may be this species.

It attains to at least $2\frac{1}{4}$ inches in length. The example, figured life-size, is from Weston-super-Mare.

6. Gobius pictus, Plate LIII, fig. 1.

Gobius pictus, Malm, Forh. Skand. Nat. 1863, p. 410; Collett, Norges Fiske, p. 56; Winther, Ich. Dan. Mar. p. 17.

Gobius minutus, (part) Günther, Catal. iii, p. 58.

Gobius laticeps, Moreau, Poiss. France, ii, p. 215, c. fig.

B. v, D. 6/10, P. 20, V. 1/5, A. 9, C. 13, L. l. 35-40, L. tr. 10-11.

Length of head $3\frac{2}{3}$ to $4\frac{1}{4}$, of caudal fin $4\frac{1}{2}$ to $4\frac{2}{3}$, height of body $5\frac{1}{2}$ to $5\frac{2}{3}$ in the total length. *Eye*—diameter $3\frac{3}{4}$ to 4 in the length of the head, 3/4 of a diameter from the end of the snout and nearly close together superiorly. Greatest width of the head slightly less than its height, it may appear much more if the fish dies in a spasm (*G. laticeps*); posteriorly the body becomes much compressed. Lower jaw slightly the longer, the posterior extremity of the maxilla reaches to beneath the front edge of the orbit. *Teeth*—fine, the outer row in either jaw being enlarged. *Fins*—The interspace between the two dorsals slight, the length of the longest spines in the first dorsal nearly equal to the longest rays in the

second. Pectoral large, and reaching to above the vent, none of its upper rays silk-like. Ventral reaches the vent, its basal membrane well developed. Caudal somewhat rounded. *Scales*—somewhat angular in form and ctenoid, none in front of dorsal fins. *Colours*—body light brown, with irregular bands, and two dark marks radiating from the lower edge of the eye. Fins light coloured, the dorsals with three or more rows of spots, and a dark outer edge. Pectoral and anal light coloured, the latter with a dark outer edge. Caudal with a dark lower margin.

The example figured "when alive, was remarkable for the brilliant colours on both dorsal fins, they are thus described in my diary, brilliant blue and green reflections (in the form of spots) on both dorsal fins (as bright as the elytra of the diamond beetle under a low power) when the sunlight falls upon them." (A. Walker, Esq., MSS.)

Habitat.—From the shores of Scandinavia and Denmark to Great Britain, while it has likewise been captured in the Channel off the coast of France.

It appears to be a small species, the example figured life-size, having been captured in Colwyn Bay, off the Welsh coast, by A. Walker, Esq. of Chester, who was good enough to send it to me. Professor Lütken has likewise sent me a similar example from Copenhagen.

7. Gobius quadrimaculatus, Plate LIII, fig. 2.

Gobius quadrimaculatus, Cuv. and Val. xii, p. 44; Guichen. Explor. Sc. Algér. p. 78; Canestr. Arch. Zool. t. i, p. 139, pl. viii, f. 1; Steind. Ich. Span. u. Port. 1868, p. 53; Moreau, Poiss. France, ii, p. 210; Giglioli, Pesc. Ital. p. 29.

Gobius Jeffreysii, Günther, Ann. and Mag. Nat. Hist, (3) xx, 1867, p. 290, pl. v, fig. C. and (4) xiii, 1874, p. 139; Collett, Norges Fis. p. 54 (*with elongated dorsal spine*).

B. iv-v, D. 6 | $\frac{1}{9\text{-}10}$, P. 17, V. 1/5, A. $\frac{1}{9\text{-}10}$, C. 13, L. l. 37-40, L. tr. 7-8.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin $6\frac{1}{2}$ to $6\frac{3}{4}$, height of body $6\frac{1}{2}$ to 7 in the total length. *Eye*—diameter $3\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout and close together. Head slightly higher than wide, snout somewhat pointed and slightly depressed: lower jaw a little the longer: the posterior extremity of the maxilla reaches to beneath the middle of the eye. *Fins*—the interspace between the two dorsal fins slight: the height of the first dorsal may equal or even exceed that of the body, while in some individuals the second spine is prolonged, extending when laid flat even to the end of the base of the second dorsal: second dorsal as high as the body. Pectoral large, and without any silk-like rays. Ventrals do not quite reach the vent. Anal with a base of less extent than that of the second dorsal. Caudal rounded. *Scales*—ctenoid: none anterior to the dorsal fins. *Colours*—yellowish gray, becoming light beneath, and a dark mark descending from the eye: four or five dark spots along the middle of the body in adults. Dorsal fins with three rows of spots. Caudal and anal with dark edges.

Habitat.—Deep sea off the Shetland Isles, but not recorded elsewhere from the Atlantic: found off the Mediterranean shores of Europe. It is common at Nice, and along the Italian coasts.

The example figured, life size, is one from the Shetland Isles, and in the National collection.

Genus II.—Aphia, *Risso.*

Brachyochirus, Nardo; *Latrunculus*, Günther (*preoccupied among Mollusks*); *Boreogobius*, Gill.

Branchiostegals five: pseudobranchiæ present. Body elongated and compressed, gill openings wide. Cleft of mouth deep. Teeth in jaws, those in the immature and females minute, in the male long and pointed, with strong and curved canines in each jaw. Two dorsal fins, the first having five spines: ventrals united to form a disc and not attached to the abdomen. Body transparent, covered with large and thin deciduous scales. Air-bladder present.

Great difficulties have occurred in the discrimination of the genus, thus when Dr. Günther (Catal. iii, p. 80) instituted that of *Latrunculus* for the female and young, he placed the male in Genus *Gobiosoma*, and likewise, though doubtfully, *Atherina minuta*, Risso, as the immature of *Atherina hepsetus*. To Professor Collett is due the credit of having found the spawning places of this fish in 1875, and elucidated its true characters (Pro. Zool. Soc. 1878, p. 319).*

This fish has been considered by Professor Collett as an example of an annual vertebrate, but the fact must not be lost sight of that some fishes are believed to die after breeding, as the common stickleback, *Gasterosteus aculeatus*, whereas if it does not breed, it certainly will live several years in an aquarium. It would be interesting to experimentalize with *Aphia pellucida* in an aquarium and ascertain if the same rule appertains to it.

1. **Aphia pellucida,** Plate LIII, fig. 3, (size $\frac{2\frac{1}{2}}{1}$.)

? Aphya cobitis, Rondel. p. 210.

Gobius pellucidus, Nardo, Giorn. Fis. Pavia, obser. &c. iii, 1824, p. 7; Kessl. Bull. Soc. Nat. Mosc. 1859, t. xxxii, No. 2, p. 260; Couch, Fish. Brit. Isles, ii, p. 171, pl. cii, f. 2.

Atherina minuta, Risso, Ich. Nice, p. 340; Cuv. and Val. x, p. 437.

Aphia méridionalis, Risso, Enr. Mérid. iii, p. 287.

Gobius albus, Parnell, Trans. Roy. Soc. Edin. xiv, 1837, p. 137; Yarrell, Supp. Hist. Brit. Fishes, p. 27, and Brit. Fishes (Ed. 2) i, p. 295 (Ed. 3) ii, p. 33; Canestr. Arch. Zool. i, p. 152, t. viii, f. 3.

Atherina hepsetus, Günther, Catal. iii, p. 393 (? young).

Atherina Stuwitzii, Dub. and Kor. Kgl. Vet. Akad, Förhandl. 1844, p. 51, t. ii, f. 4; Nilss. Skand. Faun. p. 229, Förh. Skand. Nat. July, 1863.

Latrunculus albus, Günther, Catal. iii, pp. 80, 556.

Latrunculus pellucidus, Günther, Catal. iii, p. 556; Collett, Pro. Zoo. Soc. 1878, p. 319; Giglioli, Pes. Ital. 1880, p. 30.

Gobiosoma stuvitzii, Günther, Catal. iii, p. 86.

Boreogobius stuvitzii, Gill, Proc. Acad. Nat. Sc. Phil. 1863, p. 269 (no description).

Latrunculus stuvitzii, Collett, Förh. Vid. Selsk. Christ. 1872, p. 9, and Proc. Zool. Soc. 1878, p. 319.

Gobius gracilis or *slender goby*, Couch, l. c. p. 172, pl. cii, fig. 3 (young), also *Transparent goby*, *G. pellucidus*, l. c. p. 171, pl. cii, fig. 2.

Aphya pellucida, Moreau, Poiss. France, ii, p. 238.

B. v, D. $5/\frac{1}{11-13}$, P. 16, V. 1/5, A. $\frac{1}{13-14}$, C. 17, L. l. 26, L. tr. 5, Vert. 27.

* Professor Collett remarks, p. 322, as one reason for doubting what species *Aphia*, Risso applies to, that "the number of the rays in the first dorsal fin is also omitted, which is a point of great importance." But in Ich. Nice, p. 341, it is observed by Risso, "la première nageoire dorsale contient cinq rayons." This was the *nomnat*, doubtless the form here referred to.

Length of head $4\frac{1}{2}$ to $4\frac{3}{4}$, of caudal fin 6 to $6\frac{1}{2}$, height of body $6\frac{1}{2}$ to $7\frac{1}{2}$ in the total length. *Eye*—diameter 1/4 of the length of the head, 1 diameter from the end of the snout: the interorbital space is about 1/2 a diameter of the eye in width except in the breeding males when it is twice that width. The body, except during the breeding season when the male becomes more plump (see *Breeding*, below), is elongated and compressed, with the vent about midway between the hind edge of the eye and end of the caudal fin. Mouth oblique, the posterior extremity of the maxilla reaching to beneath the middle of the eye. Numerous rows of glands pass over the cheeks. The jaws of the male augment in size and become more oblique during the breeding season. *Teeth*—similar in both sexes prior to the breeding season in a single row of 20 to 25 minute ones placed close together: in the males they are replaced at this period by a row of long pointed and rather widely separated ones, both sets may be visible a short time in the same example; in the mandible there are three or four on each side, while below and inside the last of these teeth there is a recurved canine: in the upper jaw there are about five of these long teeth on each side, and inside the row on each side a recurved canine. *Fins*—First dorsal highest in males, in which it is rather above two-thirds the height of the body below it: an interspace exists between the two dorsal fins: the second dorsal fin is rather higher than the body in adults, while the last rays decrease considerably in height. Anal similar to second dorsal. Caudal in females or young slightly emarginate, in males square with the corners occasionally rounded or the middle rays may be even produced. Ventrals in adults extend almost or quite as far backwards as the pectorals. *Scales*—cycloid, large, thin and deciduous, they are inserted into oblique muscular impressions on the body. *Colours*—transparent or pale yellow with a single row of yellowish-red points along the bases of the dorsal and anal fins which are straw coloured.

Varieties.—Parnell's descriptions apply to males taken during the breeding season, although he possessed both sexes, as Dr. Günther supplied three of them to Professor Collett, one of which was a typical female, *L. stuvitzii.*

Name.—*Nonnat*, French.

Habits.—They are free swimmers, going with moderate rapidity, not residing at the bottom. They live in large shoals and are taken in fine-meshed nets set in from one to fifteen fathoms. In the Adriatic they are in immense numbers and sold as food. They are frequently perceived coming to the surface but cannot regain the depths, being fatigued and unable to exercise sufficient compression upon their distended air-bladders. Collett says that the food in those he examined from Christiania Fjords, in both summer and winter, consisted chiefly of microscopic Copepods and other small pelagic animals. The Copepods, *Dias longiremis*, Lilljeb, *Temora velox*, Baird, together with the larvæ of decapods (*Hippolyte* and *Palœmon*) and Mollusks in their swimming stage, *Cardium.*

Breeding.—Collett considers it probable that no specimen lives more than one year, and the breeding season completed, dies without going through a second spawning, consequently they are really annual vertebrates. In Christiania Fjord they breed in the summer months, normally between the end of June and commencement of August. Spawning over all disappear. Most of the young attain their full size in December or January, no trace of adults is perceptible, and all go through the following changes. Here I propose adverting to the different appearances of this fish, as discriminated by Professor Collett, whether in the breeding season or otherwise. Out of the breeding season, there is but little difference in the appearance of the sexes, the teeth being small, of uniform size and in a single row. The *males* if nearly mature have longer jaws, and more thickened heads than the females, while external to the row of teeth described is an outer series of rather larger conical ones: the anterior rays of the second dorsal and anal are higher than the posterior ones: while the caudal is square or slightly emarginate. Mature males have a plump body and broad interorbital space, with a thickened head, and a single row of long pointed teeth: while the second dorsal and anal fins have the anterior and posterior rays of about the same height: caudal truncated or rounded. The *females*, if nearly mature, differ

from the immature fish in the belly being more swollen. Mature females do not have the head thickened, while it is somewhat more pointed than in the male: the cleft of the mouth is of less depth: the teeth unchanged, while the second dorsal and anal taper posteriorly as in the immature.

Uses.—Food for every larger fish in the vicinity, and for crustacea as well as for sea birds, but on the borders of the Mediterranean they are largely used for human beings. Along the Maritime Alps, they are the object of a distinct fishery, especially during the month of March, being considered a very *recherché* dish.

Habitat.—In innumerable numbers in the Christiania Fjord, and from the western shores of Norway along the western shores of Europe, through the Mediterranean and Adriatic, also up the Black Sea.

I have obtained them at Aberdeen: they have been recorded from the Solway Firth and Firth of Forth: also from the Bristol Channel and Weymouth and the south coast.

The example figured, $2\frac{1}{2}$ times magnified, is a male from Aberdeen. This fish does not appear to much exceed $1\frac{1}{2}$ inches in length.

Genus 3.—Crystallogobius, *Gill.*

Gobiosoma (part) Günther: *Latrunculodes*, Collett.

Branchiostegals seven: pseudobranchiæ present. Body elongated and compressed. Teeth only distinctly present in the males and in a single row, with two strong canines in the lower jaw. Gill openings wide. Two separate dorsal fins, the first composed of two spines, the second with a moderate number of rays (19-20): *anal almost similar to the second dorsal. Ventrals united forming a disc. Scales absent. Air-bladder present.*

Geographical distribution.—Coasts of Norway and Sweden, also the west coast of Scotland off Banffshire, so probably exists in intermediate localities, but has escaped detection due to its small size and being mistaken for *Aphia pellucida*. Most that is known of this fish is due to the labours of Professor Collett, from whom the greater portion of the following remarks are taken.

Crystallogobius Nilssonii, Plate LIII, Fig. 4 ($\frac{2}{1}$ *male*).

Gobius Nilssonii, Düb. and Kor. Vet. Akad. Handl. Stockh. 1844, p. 53, t. ii, f. 3; Nilss. Skand. Faun. iv, p. 227; Life of Edward pp. 375, 427.

Gobius linearis, Düb. and Kor. Ofver. Vet. Akad. Handl. 1845, i, p. 111.

Gobiosoma Nilssonii, Günther, Catal. iii, 1861, p. 86.

Crystallogobius Nilssonii, Gill, Proc. Acad. Nat. Sc. Phil. 1863, p. 269; Collett, Pro. Zool. Soc. 1878, p. 331.

Latrunculus Nilssonii, Collett, Forh. Vid. Selsk. Christ. 1872, p. 10.

Latrunculodes Nilssonii, Collett, l. c. 1874, p. 151.

B. vii, D. 2/19-20, P. 30-31, V. 1/5, A. 21, C. 14-15, Vert. 29.

Length of head $4\frac{1}{2}$ to $5\frac{1}{2}$, of caudal fin $7\frac{1}{2}$, height of body 7 to $8\frac{1}{2}$ in the total length. *Eye*—lateral, diameter 1/4 of the length of the head, 1 diameter apart in the females, a little more in the males, and 1 diameter from the end of the snout. The heads in adult males are thickened and the snout short: the cleft of the mouth deep, while the end of the mandibles are bent upwards and received into an emargination in the upper jaw. In the young males the head is more pointed, almost as in the females, in which the jaws are short, straight, and toothless. In adult males the maxilla extends backwards to beneath the hind edge of the eye. *Teeth*—These are not changed during the breeding season as observed in *Aphia*. The males at this period have 13 to 14 closely placed, small, acute, and pointed teeth in a single row in the premaxillaries, while on the projecting square extremity of the mandibles there is externally a canine at each angle and a single row of eight fine-pointed teeth extending between the canines. *Fins*—The first dorsal fin in the male commences over the base of the pectoral fin, and consists of two rays which come to a fine termination, but are not continued beyond the membrane, which extends as far as the base of the second dorsal fin. The anal is similar to the second dorsal, both consisting of short and undivided rays, except the last which is sometimes divided. Pectoral, with a broad base, and well developed, its central 12 or 14 rays are branched. Caudal square or slightly emarginate, with 9 or 10 short rays on either side of its base. Ventral reaches half way to the vent, its inner rays shorter than its outer ones. The vent is situated midway between the end of the snout and the root of the caudal fin. The angular insertions of the muscles along the side of the body are well marked, being about 27 in number. *Colours*—Almost transparent, with a light bluish tinge: a dark spot at the end of the lower jaw. A small black spot at the root of each dorsal and anal ray, those along the dorsal being sometimes wanting in the female.

Habits.—It would seem to inhabit somewhat deep water, and probably rests at

the bottom, most examples having been dredged at about 30 fathoms depth. Brought to the surface, their air-bladders become distended, as observed in *Aphia* (p. 170). Professor Collett found the stomachs of some captured in June filled with the digested remains of Entomostraca.

Breeding.—During the summer months, perhaps commencing as early as March or April. During this season the body does not increase in width as observed occurs in *Aphia.* Collett suggests that after the conclusion of the spawning the specimens no doubt perish, their life having then lasted only one year.

Life history.—The young *males*, as already observed, have the head somewhat pointed as in the females; the teeth in the jaws are visible, and all the fins normally developed. As maturity is reached the head thickens, the snout becomes short, the extremity of the mandibles are curved upwards and received into an emargination in the upper jaw, while a canine is perceptible at each angle of this prominence of the lower jaw. The young *females* have the body slender and pointed, jaws toothless, and the first dorsal and ventral fins appear to be wanting. The mature female is much more slender than the adult male, Prof. Collett finding that it required two of the former to balance in weight one of the latter. The head is pointed, the jaws straight and almost or entirely destitute of teeth; the first dorsal and ventral fins are rudimentary; the pectorals short, while the rays of the second dorsal and anal are shorter than in the males.

Habitat.—It has been recorded from the coasts of Norway and Sweden, the most northern point being Christiansund. It is evidently much rarer than *Aphia*, and partial to more northern localities.

In May, 1868, Mr. Edward obtained a male from a rock pool at Banff, which he most obligingly placed at my service, and from which my figure was taken; it is magnified to twice the natural size.

Family, XVIII—CALLIONYMIDÆ, *Richardson.*

Branchiostegals five to six: pseudobranchiæ present. Gill-openings of moderate width, or very narrow. Body mostly elongated. No osseous articulation between the preopercle and infraorbital ring of bones. Teeth in the jaws, none on the palate. Two dorsal fins, the anterior with from four to seven flexible spines; second dorsal and anal similar; ventrals wide asunder. Scales and lateral-line present or absent. Air-bladder absent.

Genus I.—Callionymus,* *Linnæus.*

Synchiropus and *Diplogrammus*, Gill.

Branchiostegals five or six: pseudobranchiæ present. Gill-openings very narrow, in some merely a small circular orifice at the upper edge of the opercle. Head and anterior portion of the body depressed. Eyes of moderate size, usually directed somewhat upwards. Mouth narrow, upper jaw protractile. A strong, variously-armed spine at the angle of the preopercle. Teeth in the jaws minute; palate edentulous. Two dorsal fins, the anterior consisting of three or four flexible spines; ventrals widely separated, each possessing five rays. Lateral-line single or double. Air-bladder absent.

These littoral fishes, commonly known as "dragonets," appear to live mostly at the sea bottom. They are extensively distributed, being found in the temperate seas of the Old World, India, the Malay Archipelago, and even beyond. In many instances they exhibit sexual distinctions either in the length of their fins, in their colours, or in both. They have been sub-divided in accordance with the size and position of the gill-openings, and whether the lateral line is single or double, as follows: (1) Gill-openings small, superior: lateral-line single. (2) Gill-openings small, superior: lateral-line double. (3) Gill-openings lateral and more extensive: lateral-line single. (4) Gill-openings lateral and more extensive: lateral-line double.

1. Callionymus lyra, Plate LIV, Fig. 1, *male;* Fig. 2, *female.*

Exocœtus, sp. Bel. p. 218. *Dracunculus*, Rondel. p. 304; Gesner, Pisc. p. 80; Aldrov. l. 2, c. 52; Willughby, p. 136, t. H 6, f. 3; Ray, p. 79; Borlase, Cornwall, p. 270, t. 26, f. 10; Seba, lii, t. 30, f. 7. *Uranoscopus* sp. Gronov. Zooph. No. 204, 205, 206 and Mus. Ich. i, p. 21, No. 63; Artedi, syn. 77. *Corystion*, sp. Klein, Pisc. MSS. iv, p. 47, No. 10. *Lyra Harvicensis*, Petiver, Gazophyl. t. xxii, f. 2. *Dragon fish*, Martens, Spitzberg. p. 123. *Floy fische*, Pontop. Norway, ii, iii; Ström, Söndm. i, p. 278. Duhamel, Pêches, ii, sect. 5, p. 116, pl. x. *The Gemmous dragonet*, Low, Faun. Orcad. p. 229; Pennant, Brit. Zool. (Ed. 1776) iii, p. 164, pl. xxvii, (Ed. 1812) iii, p. 221, pl. xxxi; also *Sordid dragonet*, l. c. p. 224, pl. xxxii.

Callionymus lyra, Linn. Syst. Nat. i, p. 433, and Faun. Suec. p. 110; Bonn. Atl. Ich. p. 43, pl. xxviii, f. 93; Bloch, ii, p. 71, f. clxi; Lacép. ii, p. 329, pl. x, f. 1; Bl. Schn. p. 39; Gmel. Linn. p. 1151; Risso, Ich. Nice, p. 103 and Eur. Mérid. iii, p. 262; Donovan, Brit. Fish. i, pl. ix; Turton, p. 88; Retz. Faun. p. 313; Müll. Zool. Dan, p. 21, pl. xxviii; Flem. Brit. An. p. 208; Couch, Trans. Linn. Soc. xiv, p. 71, and Fish. Brit. Isles ii, p. 173, pl. ciii; Jenyns, Man. p. 388; Fries, Vet. Acad. Handl. 1837, p. 39; Fries och Ekstr. Skand. Fisk. p. 95, t. xxii and xxiii; Yarrell, Brit. Fish. (Ed. 1) i, p. 261, c. fig. (Ed. 2) i, p. 297 (Ed. 3) ii, p. 310; Parnell, Fish. Firth of Forth, p. 88; Cuv. and. Val. xii, p. 266; Neill,

* Dr. Günther An. and Mag. Nat. Hist (4) 1874, xiii, p. 139, has recorded the tropical species of *Callionymus sagitta* as dredged off the Shetland Isles.

Wern. Mem. i, p. 529; Kröyer, Dan. Fiske i, p. 422: Cuv. Règne Anim. Ill. Poiss. t. lxxxii, f. i; Nilss. Skand. Fauna Fisk. p. 212; Swainson, Fishes ii, p. 280; Guichen. Explor. Sc. Algér. Poiss. p. 78; White, Catal. Brit. Fish. p. 55; Thompson, N. H. Ireland, iv, p. 117: Schlegel, Dieren Neder. 70, pl. vi, f. 6, 7; Günther, Catal. iii, p. 139; McIntosh, Fish. St. Andrew's, p. 174; Steind. Ich. Span. u. Port. 1868, p. 66; Collett, Norges Fiske, p. 62; Winther, Prod. Ich. Dan. Mar. 1879, p. 19; Moreau, Poiss. France, ii, p. 164.

Callionymus dracunculus (*female*) Linn. Syst. Nat. i, p. 433; Bonnaterre, l. c. p. 43, pl. xxvii, f. 94; Ström, Norske Selsk. Nye Handl. i, p. 149; Bloch, ii, p. 84, t. clxii, f. 2; Lacép. ii, p. 335; Bl. Schn. p. 40; Gmel. Linn. p. 1152; Risso, Ich. Nice, p. 1042; Retz. Fauna, p. 313; Müll. Zool. Dan. i, p. 434; Donovan, Brit. Fish. iv, t. lxxxiv; Turt. Brit. Fauna, p. 89; Johnston, Zool. Journ. iii, p. 336, and Berwick. Nat. Club, 1838, i, p. 172; Thompson, Pro. Zool. Soc. 1835, p. 81, and Nat. Hist. Ireland, iv, p. 118: Cuv. and Val. xii, p. 274; Yarrell, Brit. Fish. (Ed. 1) i, p. 266, c. Fig. (Ed. 2) i, p. 302 (Ed. 3) ii, p. 315; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 410; Parnell, Fishes Firth of Forth, p. 90, and Wern. Mem. vii, p. 250: Guichen. Explor. Sc. Algér. Poissons, p. 79 (not *C. dracunculus* Risso, Bonaparte, Canestrini, or Moreau).

Callionymus elegans, Lesueur, Bull. Sc. Soc. Phil. de Paris 1814, p. 6, pl. i, f. 17 (*? young*).

Uranoscopus lyra (*male*), *U. dracunculus* (*female*) and *U. micropterygius*, (*immature male*) Gronov. ed Gray. pp. 42, 43.

Dusky skulpin, Couch, Fish. Brit. Isles, ii, p. 178. pl. civ.

B. vi, D. 4/9, P. 20, V. 1/5, A. 9, C. 9, Vert. 8/13.

Length of head 4 in the male, 5 in the female, of caudal fin 5, height of body 7 in the total length. *Eye*—directed upwards and slightly outwards: lids with free edges only along the lower margin of the eyes, the skin of the head being continued over their upper portion. Interorbital space very narrow. Head broad and compressed. Snout much more elongated and pointed in the adult than in the immature males or in the females. Upper jaw protractile. A strong spine, at the angle of the preopercle, which is shorter than the eye: it is compressed and terminates in three triangular processes, two of which are directed upwards, one backwards, while a fourth at its base is pointed forwards. *Teeth*—in jaws small, absent from vomer or palatines. *Fins*—in the *male* the first dorsal ray is much elongated, reaching beyond the base of the caudal fin, while the remainder of the rays are longer than in the female. In the *female* (and immature males) the first dorsal spine is very slightly prolonged; the last ray of the second dorsal divided to its base and also elongated. The ventral rays and the seven central ones of the caudal fin are sub-divided at their extremities; the remainder are undivided. In the young males the head is broader than in the females. *Lateral-line*—single; but the two are connected together by one or two prolongations over the free edge of the tail. *Anal papilla*—prominent in adult males, slightly so in the immature, and hidden in the female. *Colours*—in the *male*: cheeks and lower half of the head orange with rounded spots and markings of ultramarine blue, some of which extend on to the upper surface of the head. The upper surface of the body yellow tinged with red, having light blue or lilac-coloured spots and markings. An ultramarine blue band passes from the upper part of the base of the pectoral fin to the base of the caudal: immediately below this is an orange stripe, and next a second blue one. First dorsal fin of a dull lemon colour, with a longitudinal reddish or lilac basal band, and vertical ones in its superior two-thirds. Second dorsal with four pale blue bands. Caudal lemon coloured and blue in about equal parts. Ventral dark bluish purple with a few lighter spots at its base. Pectoral having its upper half reddish brown, with indistinct bands. Anal with a dark outer edge. *Female* of a dull brown, becoming light on the sides and white beneath: on it are irregularly-placed darker spots and blotches, with numerous light or brown spots along the body above the lateral-line, immediately below which is an irregular row of about eight dark marks, while the lower surface is white; there are three dark bands, more

or less distinct, across the back. First dorsal bluish-black, in its posterior two-thirds; second dorsal bluish with a central yellowish band. Upper pectoral rays with some yellowish bands; ventral dusky; caudal with three vertical bands. The colours of these fish are so beautiful and fade so rapidly after death that they require being seen when alive to be appreciated. The immature males have the spots along the upper surface of the body blue.

Varieties.—Immature males coloured like females, but possessing milt or soft roe, having been captured, it was surmised that the two were sexes of one species and not identical with the gemmous dragonet: an error perpetuated by several authors. Pennant in his edition of 1812 asserted the differences were merely sexual. Neill, p. 529 (Mem. Wern. Soc.), likewise pointed out the sexes, and observed they were often taken in the Firth of Forth in from 12 to 20 fathoms water on haddock lines baited with mussels.

Names.—*Gemmous dragonet*, or the male seems to have been so termed from the brilliancy of its gem-like colours. The appellation "dragonet" was substituted by Pennant for "yellow gurnard," a name it was previously known by. It is likewise locally known as *the bridegroom* (Banffshire). *Balle-eries*, "Leries" is a "messenger" (Aberdeen). The female and young males are termed *fox* (mouth of Thames); *skulpin* or *yellow skulpin* (*male*). *Chanticleer*, *gowdie*, Scot. (*male*) gowd or gold denoting its yellow colour. *Sordid dragonet*, *dusky skulpin* (*female*). *Chiquer* (*male*) and *Doucet* (*female*) at Dieppe; *Savary*, at Caen; *Lavandiere*, at Fécamp; *Cornard*, at Brest (*male*). *Fæsing*, Norway. *Pitvisch*, Holland.

Lacépède, enraptured at its scientific and beautiful name, wrote: "What pleasing images, what touching recollections does its not recall? Celestial beauty charming our eyes—enchanting music touching our hearts: these two names happily associated restore through memory your sweet but irresistible power." Pontoppidan called it a "flying fish," as it was supposed to use its pectoral fins in order to raise itself out of the water.

Habits.—Does not appear to congregate in shoals, while the adult male is believed to prefer deeper water, as from 20 to 60 fathoms, than does the female or the young—these latter being more frequently observed closer inshore near to the edge of the tide, especially in sandy bays or at the mouths of large rivers. This fish generally remains near the bottom among stones or sand, and possesses very acute vision; it darts away immediately on being alarmed, while, according to Dr. Ball, it is able to bury itself. In an aquarium it remains quite still at the bottom of the tank, and even covers itself with sand except merely the top of the head as far as the gill-openings. Now and then it will dart along for a short distance, and then settle down again often at the very spot from where it set out. It feeds on testaceous animals which it swallows entire, also on worms and molluscs. It lives some time after removal from the water. Mr. Dunn on May 24th, 1881, obtained at Mevagissey a yellow sculpin caught in a mackerel net at the surface of the sea 14 miles from land and in 40 fathoms water.

Means of capture.—Usually by trawls and nets; while small ones are taken in sandy bays by shrimpers. Pennant observes that in his time it was often secured by the hook in 30 or 40 fathoms water off Scarborough. It is frequently found in the stomach of the cod. A fisherman informed Thompson that he occasionally took this fish on long lines set on muddy but never on sandy bottoms. Off some localities on the south-west coast its preopercular spine is believed to occasion a poisonous wound.

Baits.—Although it occasionally takes a bait, the size of its mouth precludes large hooks being employed for this purpose.

Breeding.—Dr. G. Johnston (Zool. Journal, iii, p. 336) recorded having found a sordid dragonet containing milt or soft roe, it being a young male. The Rev. G. Harris (Zool. p. 2999 and 3118) mentions having discovered hard roe in a gemmous dragonet, which, provided the observation were correct, is interesting as seeming to show that the female might assume the colours of the male and still not be sterile. The observation does not seem to have been confirmed by any other naturalist.

As food.—Its flesh is white and firm.

Habitat.—The coasts of Norway, Denmark, and the German Ocean, but reputed not to extend to the Baltic: found round the British Isles: it is not rare off the French coast, but exceedingly uncommon in the Mediterranean.*

Couch has with justice observed that "the habits of naturalists rather than of the fish have caused it to be regarded as rare" around the British Isles. In the Orkneys Lowe obtained a single male example about 6 inches in length entangled among the sea-ware; while Baikie remarked upon its being rare in the Orkneys and Zetland. It is occasionally found off Banffshire (Edward). It has likewise been recorded from the Moray Firth, and Lossiemouth: at St. Andrews it is common in deep water, and in the stomach of the cod (McIntosh). In the Firth of Forth it is common, and after storms from the east has been captured as far inland as Alloa and Kincardine (Neill). It has been recorded from Cumberland and along the east coast, but stated by Lowe to be very rare off Yarmouth. Along the south coast it is by no means uncommon, and extends up the Bristol Channel.

In Ireland it is occasionally found all round the island. Templeton in 1821 recorded a fine specimen taken in Carrickfergus Bay, while a female was also found inside a cod fish. At Belfast it is not uncommon, and one 8 inches in length was secured at Donaghadee.

It attains to at least 12 inches in length. The examples figured, life size, were from Southend at the mouth of the Thames.

2. **Callionymus maculatus,** Plate LIII, fig. 5 (male).

Dracunculus, Rondel. x, c. 12, p. 304; Aldrov. ii, c. 51, p. 262; Willughby, p. 136, t. H 6, f. 3; Ray, p. 79. *Cottus*, sp. 5, Artedi, Genera, p. 49, and sp. 4, Synon. p. 77.

Callionymus maculatus (Rafin.) Bonap. Fauna Ital. Pesci, fig. 2, male, fig. 3, female; Schagerstr. Vet. Akad. Handl. 1833, p. 133; Fries, *ibid.* 1837, p. 48; Fries och Ekstr. Skand. Fisk. p. 102, pl. xxiv; Kröyer, Dan. Fiske, i, p. 442; Nilss. Skand. Fauna, Fisk. p. 216, Günther, Catal. iii, p. 144, and Ann. and Mag. Nat. Hist. (3) 1867, xx, p. 290; Steind. Ich. Span. u. Port. 1868, p. 66; Winther, Prod. Ich. Dan. Mar. 1879, p. 19; Collett, Norges Fiske, p. 62; Giglioli, Pesc. Ital. p. 30; Moreau, Poiss. France, ii, p. 169.

Callionymus lyra, Risso, Ich. Nice, p. 113, and Eur. Mérid. iii, p. 262.

Callionymus dracunculus, Brünn. Pisc. Mass. p. 17; Nardo, Prod. Adr. Ich. sp. 46.

Callionymus cithara, Cuv. Règne Anim; Cuv. and Val. xii, p. 280.

Callionymus reticulatus, Cuv. and Val. xii, p. 284.

B. vi, D. 4/9–10, P. 16, V. 1/5, A. 8-9, C. 9-10.

Length of head 4 to $4\frac{2}{5}$, of caudal fin 6, height of body 9 to 13 in the total length. *Eye*—directed upwards and outwards, 1/3 to 1/4 of the length of the head, and $1\frac{1}{4}$ diameters from the end of the snout; interorbital space narrow. Head broad and depressed, its width being $1\frac{1}{2}$ to $1\frac{2}{5}$ in its length. Snout rounded. Upper jaw protractile; the posterior extremity of the maxilla reaches to beneath the front edge of the eye. A strong spine, much shorter than the eye, exists at the angle of the preopercle, it is compressed and armed with three or four pointed processes, much less developed than in *C. lyra*: two are directed upwards, while the lower spine has a process pointing anteriorly at its base, but which is occasionally absent. *Teeth*—in jaws small; absent from vomer and palatines. *Fins*—in the *male* both the dorsal fins are much elevated, the first spine of the anterior fin equalling from 1/3 to 2/5 of the total length, and much higher than the succeeding ones; second dorsal three times as high as the body below it. In the *female* the first dorsal fin is triangular, much lower than in the

* In the British Museum Catalogue examples stated to have come from the Adriatic and the Mauritius are considered by Dr. Günther to pertain to this species.

male, as its height merely equals that of the body. *Colours*—gray, becoming light beneath ; several oval, pearl coloured spots, some of which on the side of the body, are surrounded by a dark ring. Fins light coloured, the dorsal with three or four rows of round black spots encircled by a pearly ocellus. Three or four vertical bands cross the pectoral fin : ventral dark in its outer half. Anal edged with deep gray. Caudal dark in its posterior half.

Habits.—Probably much the same as those of the last species, but little is known of them.

Habitat.—Scandinavia and the coast of Denmark, while an example has been dredged off the Shetland Isles, and placed in the British Museum. It does not appear to have been recorded on the Atlantic coast of France, but becomes more common in the Mediterranean extending to the Adriatic.

The example figured is the British specimen alluded to.

Family, XIX—DISCOBOLI (part), *Cuvier.*

Body rounded, transversely expanded or oblong. Teeth minute. Gill-openings narrow. Gill-membranes attached to the isthmus. Gills, three and a half. One or two dorsal fins, the anal being similar to the second dorsal. Ventrals each with one spine and five rudimentary rays, which form the centre or framework of a round suctorial disc, which has a skinny outer margin. Air-bladder absent. Pyloric appendages numerous, or in moderate numbers.

Cuvier's *Discoboli* included the *Gobiesocidæ* in addition to the fishes as here restricted, which having their ventral fins forming a suctorial disc allies them to the gobies. They have been divided as follows:—

A. Two separate dorsal fins—*Cyclopterina.*

B. One dorsal fin: the infraorbital ring of bones not articulating with the preopercle—*Liparidina.*

Geographical distribution.—Mostly littoral and carnivorous fishes, some of which are of a small size, while all can attach themselves to rocks or other desirable objects by means of their suctorial discs. They are found from the Arctic Ocean to the more temperate regions of Europe and America.

Genus I.—Cyclopterus, *Linnæus.*

Lumpus, Cuvier.

Branchiostegals six: pseudobranchiæ present. Body short, thickened, and more or less elevated. Villiform teeth in the jaws, none on the palate or tongue. Gill-openings narrow, the gill-membrane being attached to the isthmus: gills three and a half. Two dorsal fins, the anterior, which may become more or less atrophied in the adult, is formed of flexible spines. Ventral consisting of one spine and five rays, the two united so as to form a somewhat circular disc. Second dorsal opposite and nearly similar to the anal. Skin loose, viscous, having tubercles in rows as well as scattered. Skeleton but slightly osseous.

Gill has instituted genus *Eumicrotremus* for the reception of *Cyclopterus spinosus* of Fabricius.

Geographical distribution.—As observed for the Family.

The modification of the ventral fins into a suctorial disc enables these fishes to inhabit regions which would otherwise be fatal to their existence, as during storms should they not be firmly attached to some unyielding substance, their unwieldly bodies would soon be beaten to death by the waves or dashed on to the shore. Mr. A. Wilson (Nature, June 26th, 1879) suggests whether this sucker may not have been developed by natural selection as an useful adjunct to the breathing movements of the fish, as when fixed it appeared to be perfectly at its ease, and to breathe more fully and strongly than when swimming about.

1. Cyclopterus lumpus, Plate LV.

Cyclopterus gibbosus, Willughby, p. 209, t. N 10, f. 2. *Lumpus Anglorum*, Aldrov. iii, c. 68, p. 479; Jonston, i, tit. 1, c. 3. art. 3, punct. 12, p. 42, t. xiii, f. 1; Willughby, p. 208, t. N 11; Ray, Syn. p. 77. *Lepus marinus*, Schonev. p. 41. *Cyclopterus*, sp. Artedi, Gen. p. 62; Gronov. Mus. Ich. i, p. 56; Gouan,

Hist. Pisc. p. 223. *The Lump-sucker*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 133, pl. xxi (Ed. 1812) iii, p. 176, pl. xxiv. *Oncotion*, No. 1, 2, 3, Klein, MSS. Pisc. iv, p. 49, t. xiv, f. 5; Ascan. Icon. t. xxxiv. *The Lump-fish*, Low, Nat. Hist. of Orkneys, p. 177.

Cyclopterus lumpus, Linn. Syst. Nat. i, p. 414 and Faun. Suec. p. 320; Bonn. Atl. Ich. p. 26, pl. xx. f. 63; Fabr. Faun. Grönl. p. 131; Mohr. Isl. Nat. p. 61; Bloch, Fis. Deut. ii, p. 103, pl. xc; Bl. Schn. p. 197; Lacép. ii, p. 52, pl. iii, f. 1; Gmel. Linn. p. 1473; Müll. Prod. Zool. Dan. p. 39; Donovan, Brit. Fish. i, pl. x; Turton, Brit. Fauna, p. 115; Cuv. Règ. Anim.; Faber, Fis. Isl. p. 49; Retz. Faun. p. 327; Rich. Faun. Bor. Amer. Fishes, p. 260; Ekstr. Fisk. Mörkö, p. 108; Nilss. Prod. p. 61 and Skand. Faun. Fisk. p. 232; Fries, Vet. Akad. Hand. 1838, t. iv, f. 1; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 412; Johnston, Berwick. Nat. Club. 1838, i, p. 174; Düben and Koren, Vet. Akad. Handl. 1844, p. 116, t. iii, f. 8; Yarrell, Brit. Fish. (Ed. 1) ii, p. 270, c. fig. (Ed. 2) ii, p. 365 (Ed. 3) i, p. 343; Flem. Brit. An. p. 190; Kröyer, Dan. Fis. ii, p. 489; Parnell, Wern. Mem. vii, p. 380 and Fish. Firth of Forth, p. 220; Swainson, Fishes, ii, p. 339; Jenyns, Man. p. 471; Gronov. ed. Gray, p. 39; Gaim. Voy. Isl. &c. pl. viii; Thompson, N. Hist. Ireland, iv. p. 215; Günther, Catal. viii, p. 155; White, Catal. Fish. p. 109; Gill, Pro. Ac. N. Sc. Phil. 1864, p. 190; Schlegel, Dieren Ned. p. 58, t. vi, f. 1; McIntosh, Fish. N. Uist, P. R. Soc. Ed. V. 1862-66, p. 614 (*young*) and Fish. St. Andrew's, p. 174; Collett, Norges Fiske, p. 63; Winther, Prod. Ich. Dan. Mar. 1879, p. 19; Moreau, Poiss. France, iii, p. 349.

Cyclopterus pavoninus, Shaw, Nat. Misc. ix, p. 310 (*young male*).

Cyclopterus cœruleus, Mitchell, Trans. Lit. and Phil. Sc. New York, i, p. 480, pl. ii, f. 7.

Lumpus Anglorum, De Kay, New York Faun. Fishes, p. 305, pl. liv, f. 175.

Cyclopterus coronatus, Couch, Corn. Fauna, p. 47, Ann. Nat. Hist. ii, p. 382; Thompson, An. and Mag. Nat. Hist. v, p. 9, and Nat. Hist. Ireland, iv, p. 216.

Gobius minutus, Müll. Zool. Dan. p. 38, t. cliv, B. f. 1-3 (*young*).

Cyclopterus minutus, Pall. Spic. Zool. vii, p. 12, t. iii, f. 7-9; Rich. l. c. p. 262; Kröyer, l. c. ii, p. 491; Cuv. Règ. Anim.

Lepadogaster minutus, Bl. Schn. p. 3.

Lump-fish, Couch, Fish. Brit. Isles, ii, p. 183, pl. cv.

B. vi, D. 4-6/10-11, P. 20-21, V. 1/5, A. 9-10, C. 10-11.

Length of head 4 to $4\frac{1}{2}$, of caudal fin $5\frac{1}{2}$ to 6, height of body $2\frac{1}{3}$ to 3 in the total length. *Eye*—high up and in the anterior half of the head, about 2 diameters in the very young, more in the adult, from the end of the snout, and 2 or 3 diameters apart. Interorbital space nearly flat. The maxilla reaches to beneath the middle of the eye. Gill-opening in the form of an oblique cleft, above the anterior half of the pectoral fin and ceasing opposite the centre of the base of that fin. *Teeth*—a band in either jaw of fine pointed ones: none on the vomer or palatine bones, nor on the tongue. *Fins*—first dorsal only seen in the young, becoming enveloped in thick skin as age advances: fin rays simply divided near their outer extremities (see *Life History*, p. 182). Ventral fins united so as to form a sucker, its rays undivided, the base of each expanded. Body covered with tubercles, among which may be distinguished four enlarged rows, one along the back, the second from above the eye to the upper half of the caudal fin, the third from the angle of the mouth continued above the pectoral fin to the lower half of the caudal: while the fourth passes from below the pectoral fin to the base of the anal. Numerous small tubercles exist over the head and body. *Stomach*—horse-shoe shaped and with about 50 cœcal appendages more or less coalescing one with the other. *Colours*—these differ according to sex, speaking generally, the male, especially on its sides and beneath, is red, and the female blue or even nearly black, but during the breeding season the tints become much brighter and more varied. There are dark or even black spots irregularly scattered over the body. The young are usually green, occasionally yellow, or both colours conjoined.

Varieties.—The young are sometimes yellow, but more usually of a brilliant

emerald green, this last colour being sometimes continued in the adult, the sides being tinged with crimson. Shaw (Nat. Misc. ix, p. 310) considered such to be a different species (*C. pavoninus*) : while those possessing a prominent pyramidal elevation on the back (due it has been surmised to bad stuffing) have been termed *C. pyramidatus* (Shaw).

Names.—*Lump-sucker*, due to its lumpy form and possessing a suctorial disc. *Paddle-cock*, Scotland, owing to its dorsal ridge enveloped in tubercular skin, resembling the comb of a domestic cock: also *cock-* and *hen-paidle* or *red-* and *blue-paidle*, according to sex. Locally known as *sea-owl* and *hush-bagaty*. *Jar-for*, Welsh. *Snotdolf*, Dutch. *Lompe*, *grosmollet*, and *lievre de mer*, French.

Habits.—It is very tenacious of life, but inactive adhering firmly to rocks, and rarely moving except when in pursuit of food, or during migrations: it has, however, been said to progress with greater velocity than its appearance would credit it with. Coming in-shore about March it usually retires to deeper waters after August, or else conceals itself during winter under rocks, to which it frequently attaches itself. Its food consists of marine worms and small fish: while crustaceous animals, as *Onisci*, have been found in its stomach.

In its way it is sometimes a "commensal," as is the Echeneis, only it adheres to floating objects, usually inanimate, for the purpose of being transported from one locality to another. Couch alludes to an example found adhering to the skin of a mackerel that had become entangled in a drift net over a considerable depth of water. "As a proof of its tenacity, we have known that on plunging a fish of this species, just caught, into a pail of water, it fixes itself so firmly to the bottom, that on taking it by the tail, the whole pail by that means was lifted, though it held some gallons, and that without removing the fish from its hold" (Pennant).

Means of capture.—The trawl, the trammel, or other nets; while Mr. Cornish (Zool. p. 3532) records a male full of milt, and nearly as large as a full grown female, taken on March 28th, 1873, at Penzance, in about 30 fathoms of water, by means of a surface mackerel net. This specimen instead of being red "was of the usual dull leaden blue of the female over the back, inclining to the usual dirty white on the belly." In the Zoologist for 1876 (p. 4961) the same observer records two females of this species captured in mackerel drift nets at Penzance fishing at the surface of deep water. Couch likewise remarks upon their occasionally being taken in this way.

Baits.—Rarely takes a bait although it has been known to do so.

Breeding.—Adults come in-shore for this purpose from March until May. Bloch counted 207,700 eggs in a fish 6½ lb. in weight: in April, 1836, one which was 15 inches in length contained a vast quantity of rose-coloured ova, weighing 25 oz. and having 101,935 ova (Thompson). In February, 1880, one of 11 lb. weight had about 194,112 eggs (Buckland). "Fabricius related that the Lump-sucker in April or May, enters the rocky bays of the Greenland coast for the purpose of spawning: that the female, preceding the male, deposited the roe among the large *Algæ* in the fissures of the rocks: that, followed by the male shortly afterwards, she finally left him fructifying the eggs and adhering to the masses of roe till the eggs were hatched, and that he fought other fishes while watching and guarding the important deposit. Johnston observes (Berwick. N. H. F. Club, 1838, i, p. 174) "The paidle spawns towards the end of March and in April. At that season the *hen* approaches the shore and deposits her spawn among the rocks and sea-weed within low water-mark, and immediately afterwards returns to deeper water. The male then covers the spawn with his sperm, and, according to the testimony of our fishermen, remains covering it, or near it, until the ova are hatched. The young soon after birth fix themselves to the sides and on the back of their male parent, who sails, thus loaded, to deeper and more safe retreats. He is only one half the size of the hen, and at the breeding season his belly becomes of a reddish colour. The spawn of a single female will fill a large basin, and is of a beautiful pink colour: the eggs globular and about the size of swan shot." At Gamrie, in Banffshire, Mr. G. Harris, Zoologist, 1851, ix, p. 3157, observes—"Upon this coast their *nests* are

almost invariably to be met with in rocky places, a little beyond low water-mark. There is also this peculiarity, that the sites of these are usually cavities, from 8 to 10 inches in diameter, opening horizontally into the water. Mr. West, of Pennan, informs me that in one case he came upon a *hen* seated on her nest, just, he supposed, as she had completed the process of spawning. She adhered very tenaciously, manifesting at the same time considerable intrepidity, which seemed to be shared by her companion, the *cock*, who, during the struggle kept close by, flitting through and through the water in a state of violent agitation." Fabricius even affirms that should the *Anarrhichas*, or wolf-fish, approach the nest of this fish he hazards his life, for although the teeth of the lump-sucker are small, it is able to attach itself to its adversary's neck and inflict a wound which will be mortal. Sharks and rays will devour the lump-fish.

Life history.—The changes undergone by this fish, both as to the form of its body, its fins, the character of its skin, and its colours, are very remarkable. I am indebted to Mr. Jackson, of the Southport Aquarium, for some of the fry from one to three days old, hatched in that institution, and to Mr. Carrington, of the Westminster Aquarium, for a fine series, but of a larger size. On first emerging from the egg, and for the first few days, or even weeks, of its life, its appearance when looked at from above is much that of a young tadpole, the body forming an oval anteriorly, flattened from above, while the posterior half or rather more of the fish is narrow and strongly compressed: no tubercles are present on any part of the body. At a little over $1\frac{1}{2}$ inches, the first dorsal fin is distinct, with about six rays, but its base is rather fleshy, and on its anterior edge are two spinate tubercles, the lower being the larger. A row of spinate tubercles runs along the back: a second from above the eye to the centre of base of the caudal fin: while a third similar row is well developed along either side of the abdominal edge, ceasing at the vent. Between these tubercles the skin is entirely smooth. At 2 inches the first dorsal fin is more enveloped in rough skin, and the skin between the rows of tubercles has commenced to be covered with small but rough tuberosities. At $2\frac{1}{2}$ inches the dorsal ridge and the rough skin enveloping the first dorsal fin have become more developed, while at 6 inches, as shown in the figure, merely the ends of some of the rays of the first dorsal fin are perceptible, the back at this situation forming a large and almost pyramidal elevation. The skin between the rows of spinate tubercles is also densely studded with small elevations.

As food.—The quality of its flesh is said to be affected by the season, it becoming worthless after spawning, but due to the odour it exhales it is generally rejected: it is said to dissolve in the mouth like mucilage or oil. Pennant remarks that in his time it was sometimes eaten in England, being stewed like a carp, but he considered it to be both flabby and insipid. Donovan likewise asserted that skinned and stewed by some its flesh was thought to be not indifferent. Sir T. Brown, in 1662, recorded it as "esteemed by some as a festival fish, though it affords but a glutinous jelly, and the skin is beset with stony knobs after no certain order." Pennant observed that the seals prey on them, leaving the skins, numbers of which thus emptied float ashore during spring on the coast of Sutherland. Johnston, writing from Berwickshire, remarked that although not in use as food, the cock especially, is reported to be excellent when fried or baked. Buckland records that the males are the best as food, their flesh is soft, rich, and oily, and some inhabitants of Edinburgh deem it second only to turbot if fried or baked: while Sir Walter Scott, in the Antiquary, makes Mr. Oldbuck offer the same price for a cock-paidle as he does for a bannock-fluke or turbot. "On the west coast of Scotland," remarks Parnell, "sometimes as many as two dozens are taken in the salmon nets at almost every tide, principally in the month of June, when they seek the sandy ground to deposit their spawn. The fishermen boil them down with vegetables for their pigs and consider them to be fattening food." The roe is boiled to a pulp and eaten by the Greenlanders.

Habitat.—Most abundant in cold latitudes, it extends from the seas of Northern Europe, being found off Iceland, along the coasts of Scandinavia, Denmark, and

North Germany, to Great Britain and Ireland, also the Channel Isles and Atlantic coasts of France, having been recorded from Boulogne, Havre, and Roscoff, but becoming rare in the Gulf of Gascogne. In the New World it extends from Greenland and the Polar regions to New York and Cape Hatteras.

Very frequent, as noticed by Low, in the Orkneys and Shetlands (Baikie), especially on the sand banks, where half a dozen are drawn ashore at once but never of any great bulk. Also along the Scottish coasts: Thompson mentions its existence in Ayrshire: Edward at Banff: Sim at Aberdeen: it is found at Montrose and St. Andrew's, at which latter place McIntosh observes that it is common on the west sands after storms and occasionally in the stomach of the cod, while the young abound in rock pools in autumn. It has likewise been recorded at various places around the English and Welsh coasts, as Berwickshire, also Yarmouth by Paget in 1819, one from which same locality, taken in January, 1848, and weighing 13½ lb., is now in the Norwich Museum; while at Lynn a fine male example was captured March 30th, 1853, perhaps carried up the river by a flowing tide. It had probably entered the bay after small herrings and smelts, which were being captured by the fishermen. It has frequently been taken and it is not rare along the south coast, but becomes less numerous in Cornwall, where, however, it is common in particular localities: Mr. Cornish (Zool. 1874, p. 4037) finds the female is not uncommon at Penzance, but the male to be rare.

In Ireland it is captured around the coast, but Templeton observes that it is not very common, and Thompson subsequently that on the north-east they are taken, seldom more than one or two at a time, during the breeding season, in nets set for various fishes, as it generally enters arms of the sea in spring to deposit its ova.

This fish attains to a considerable size, the female being usually larger than the male: one of the former was captured in Jersey in 1879 which weighed 15½ lb. Storer mentions an American example which weighed 17 lb. Thompson records an Irish specimen which measured 23½ inches in length, and it is rare for the lump-sucker to exceed 2 feet. The example, figured life size, was obtained off the coast of Sussex.

Genus 2.—Liparis, *Artedi.*

Cyclogaster, Gronov.

Branchiostegals five or six: pseudobranchiæ, if present, rudimentary. Body anteriorly subcylindrical, posteriorly compressed, the whole being enveloped in a loose, movable skin. A bony process proceeds from the infraorbital ring of bones and passes backwards to the edge of the preopercle. Cleft of mouth almost horizontal. A wide, rasp-like, band of teeth in both jaws, none on the palate nor on the tongue. Gill-openings narrow, the gill membranes united and attached to the isthmus. A single dorsal fin, the anterior rays of which, though not articulated, are flexible: ventrals united, and forming a more or less circular adhesive disc. Cœcal appendages in moderate numbers or numerous.

Gill remarks (Proc. Acad. Nat. Sc. Phil. 1864, p. 190) that among the species forming this genus considerable variation exists, especially in the relations of the dorsal and anal fins to the caudal, these fins being, in some species, completely isolated, while in others they are coalescent, and united in an almost anguilliform posterior fin. In the latter, the nostrils also appear to be simple, while in the former the posterior ones are tubular. These differences appear still further to be coincident with a disparity in the number of caudal vertebræ, and of the rays of the vertical fins.

Geographical distribution.—These small littoral species occasionally ascend into fresh waters, and extend from the Arctic Ocean southwards into temperate regions: one species being found even within the tropics. Two British species are admitted, but it seems possible that the one known as *Liparis Montagui* is the commonest, and not *L. vulgaris*, unless in the more northern latitudes. Neither is *L. Montagui*, although termed the diminutive sucker, so much less in size than the "unctuous sucker." Unless in colour, the differences between the two are but slight.

1. Liparis vulgaris, Plate LVI, fig. 1.

Sea snail, Willughby, Ich. Append. p. 17; Low, Nat. Hist. Orkneys, p. 178; Petiver, Gazoph. t. li, f. 5. *Liparis nostras*, Will. Appendix, p. 17, t. H 6, f. 1; Ray, p. 74. *Gobio*, sp. Kölr. Nov. Comm. Petroph. ix, p. 439, t. ix, f. 5, 6. *Cyclogaster*, sp. Gronov. Zooph. No. 198, Act. Helv. iv, p. 265, No. 165, t. xiii. *Liparis*, sp. Bl. Schn. p. 569. *Unctuous sucker*, Penn. Brit. Zool. (Ed. 1776) iii, p. 135, pl. xxi (Ed. 1812) iii, p. 179, pl. xxiv.

Cyclopterus liparis, Linn. Syst. Nat. i, p. 414; Bonn. Atl. Ich. p. 27, pl. xx. f. 67; Bl. t. 123, f. 3, 4; Gmel. Linn. p. 1477; Lacép. ii, p. 69; Donovan, Brit. Fish. ii, pl. xlvii; Turton, p. 115; Johnston, Berwick. Nat. Club. 1838, i, p. 174; Schleg. Dieren Neder. p. 60, pl. vi, f. 2.

Liparis vulgaris, Flem. Brit. An. p. 190; Yarrell, Brit. Fish. (Ed. 1) ii, p. 274, c. fig. (Ed. 2) ii, p. 371 (Ed. 3) ii, p. 349; Nilss. Skan. Faun. p. 237; Flem. Brit. An. p. 190; Jenyns, Brit. Vert. p. 472; Kröyer, Dan. Fiske, ii, p. 534; Parnell, Wern. Mem. vii, p. 383, and Fishes Firth of Forth, p. 223; Thompson, Nat. Hist. Ireland, iv, p. 221; White, Catal. Fish. p. 109; Günther, Catal. iii, p. 159 and Ann. and Mag. Nat. Hist. (4) 1874, xiii, p. 139; McIntosh, Fish. N. Uist. P. R. S. of Edin. V. 1862-66, p. 614, and Fish. St. Andrew's, p. 175; H. Malmgren, Spets. Fisk Fauna, p. 510; Moreau, Poiss. France, iii, p. 353; Winther, Prod. Ich. Dan. Mar. 1879, p. 20.

Liparis communis, Sabine, Appen. Parry's first Voy. p. 212.

Liparis barbatus, Ekst. Vet. Ak. Hand. 1832, p. 168, t. v, and Fisk. Scheer. Mörkö, p. 112, t. v; Nilss. Skan. Faun. Fisk. p. 237; Kröyer, ii, p. 534.

Liparis ophidoides, Swainson, Fishes, ii, p. 339.

Cyclogaster liparis, Gronov. ed. Gray, p. 40.

Liparis lineatus, Collett, Norges Fiske, p. 65.

Sea snail, Couch, Fishes of the British Isles, ii, p. 190, pl. cvi.

(*Varieties.*)

Liparis musculus, Lacép. iv, p. 683.

Liparis lineatus, Kröyer, Nat. Tids. ii, 1847, p. 284; Gaim. Voy. Scand. Poiss. pl. xiii, f. 2.

B. v-vi, D. 34-36, P. 28, V. 1/5, A. 27-28, C. 12-14, Vert. 12/30.

Length of head 4, of caudal fin 7½, height of body 4 in the total length. *Eye*—small, rather in front of the middle of the length of the head, the length of the snout equalling the width of the interorbital space, and equal to from 2 to 2½ diameters of the orbit. Head broad, its greatest width equalling three-fourths of its length: body much compressed posteriorly, commencing opposite the origin of the anal fin. Snout broad. Mouth anterior, wide, the maxilla reaching posteriorly to beneath the front edge of the eye: the upper jaw slightly the longer. Nostrils small, patent: the posterior one nearer the eye than to the upper lip. No barbels. *Teeth*—small, disposed in both jaws in oblique rows, most numerous in the upper jaw: none on vomer, palatines, or tongue, which last organ is very thick. *Fins*—the dorsal commences over the middle of the pectoral, being lowest anteriorly, while it scarcely joins the base of the caudal. Pectorals reach to above the base of the anal, they are broad, extending downwards, and forwards under the throat, the lower six rays being rather elongated, causing the fin to appear notched. Ventrals each with six rays surrounding the disc, which is rather longer than broad, and equal in diameter to about half the length of the head. Anal commences below the sixth or seventh dorsal ray, is rather higher than the dorsal, while its last ray is connected to the base of the caudal, which latter is nearly square at its extremity. Vent about midway between the hind edge of the disc and the commencement of the anal fin. Skin very loose, extending over the fins. *Colours*—of a pale gray or brown, having irregularly distributed narrow and horizontal darker bands, sometimes of a purplish colour, and most distinct on the anterior portion of the body: outer half of dorsal and anal fins brown, due to dark narrow lines. Pectoral and caudal yellowish with rows of dark spots. But, as Donovan observes, its colours differ considerably at different seasons as well as at stages of its growth. Young examples have been seen with the under surface white, pale yellow, or even rosy, while the sides of the head are of the same colour as the body. Yarrell states that many examples are without streaks or lines, the edges of the dorsal and anal fins only being edged with a darker colour.

Varieties.—Donovan mentions an example in which the body was chestnut colour, strongly marked with longitudinal streaks and lines of white edged with blue: Mr. Holdsworth, according to Couch, met with one which was blotched all over with white on a very dark ground, not unlike some individuals of *Cottus bubalis*. Collett gives a detailed account of the local forms (1) *L. assimilis* (2) *stellatus* or *Liparis stellatus*, Malm. (3) *subfuscus*, (4) *scorpioides* (5) *mixtus*, (6), *decorus*, (7) *scriptus*, (8) *lineatus* or *Liparis lineatus*, Kröyer, (9) *arcticus*, (10) *fuscus*.

Names.—*Sea snail*, due to the soft character of its body: *unctuous sucker*, from its feel and adhesive apparatus.

Habits.—It appears to generally remain in localities not far removed from low water mark, and is occasionally found in estuaries and some little distance up the mouths of muddy rivers, but rarely out of tidal influence. It appears to feed on small crustacea and other minute animal substances.

Means of capture.—Trawling and dredging, or taken under rocks on the tide receding.

Breeding.—Pennant found it full of spawn in January. Other observers have believed it to breed about February, and McCulloch says that it may ascend rivers from the sea to deposit its spawn, which is more usually found near the river's mouth. The eggs are small and numerous: if anything, of less size than in *L. Montagui*.

As food.—Not eaten except in Greenland.

Habitat.—In America it has been captured from the Polar regions to Cape Cod: and in Europe it extends from the same high latitudes to Scandinavia, Denmark, Holland, the coasts of Great Britain, and to the Channel and the shores of France (Moreau). Koelreuter recorded it from Smyrna in the Mediterranean, which more recent naturalists consider must have been due to some error.

In the Orkneys it is found under the stones round the shores of many places (Low), Orkney and Zetland common (W. Baikie), and at the point of Ness, at Stromness, they may be fished up by dozens: it has been dredged by Gwyn Jefferies in the deep sea between the Shetlands and Faröe. Of partial occurrence off Banff (Edward), at Aberdeen (Sim), also at St. Andrew's (McIntosh), and occasionally in the Firth of Forth, even above Alloa (Parnell). In Berwickshire it is not uncommon (Johnston), and although asserted to be common in Yorkshire (Clark), perhaps the next species is included. It is said not to be common in Norfolk. Couch records it off the mouth of the Thames, while along the south coast it has been taken at Exmouth, Weymouth, and off Falmouth: said to be common at Plymouth (Reading), also found in Cornwall where, however, it is rare. At Weston-super-Mare, in Somersetshire, I found it to be common.

Ireland.—In the Ordnance Survey Memoir (p. 14, Notices) said to be taken at Lough Foyle and Larne: Thompson, however, who examined their eight specimens, considered them to be *L. Montagui:* he observes the same of McCalla's Roundstone specimen, and doubts if this species exists among any of the genus which had been recorded as Irish.

It attains to at least 6 inches in length.

2. **Liparis Montagui,** Plate LVI, fig. 2.

Gobius, Zool. Dan. iv, p. 16, t. cxxxiv.

Cyclopterus Montagui, Donovan, Brit. Fish. iii, pl. lxviii; Mont. Wern. Mem. i, p. 91, pl. v, f. 1; (*C. Montacuti*) Turton, Brit. Faun. p. 115; Pennant, Brit. Zool. (Ed. 1812) iii, p. 183; Johnston, Berwick. Nat. Club, 1838, i, p. 175.

Liparis Montagui, Cuv. Règ. Anim.; Yarrell, Brit. Fish. (Ed. 1) ii, p. 277, c. fig. (Ed. 2) ii, p. 374 (Ed. 3) ii, p. 352; Gaim. Voy. Skand. Poiss. pl. xiii. f. 1; Nilss. Skand. Faun. Fisk. p. 239; Flem. Brit. An. p. 190; Jenyns, Brit. Vert. p. 473; Templeton, Mag. N. Hist. 1837 (2), i, p. 412; White, Catal. Fish. p. 110; Kröyer, Dan. Fis. ii, p. 519; Malm. p. 451, t. vii, f. 1; W. Thompson, Mag. N. Hist. 1839 (2) iii, p. 586, and Nat. Hist. Ireland, iv, p. 221; Günther, Catal. iii, p. 161; Putman, P. Am. Ass. 1874, p. 335; McIntosh, Fish. St. Andrew's, p. 175; Collett, Norges Fiske, p. 63; Winther, Ich. Prod. Dan. 1879, p. 20.

Liparis gobius, Schager. Vet. Akad. Handl. 1838, p. 248.

Cyclopterus liparoides, Nilss. Prod. Ich. Scand. p. 62.

? Lepidogaster Cornubiensis, Thomp. Proc. Zool. Soc. 1835, p. 81.

Montagu's sucker, Couch, Fish. Brit. Isles, ii, p. 193, pl. cvii, fig. 1 and 2.

Network sucker, Couch, Fish. Brit. Isles, ii, p. 195, pl. cvii, fig. 3.

B. v-vi, D. 26-30, P. 30, V. 6, A. 24, C. 14, Cœc. pyl. 16, Vert. 10/25.

Length of head $3\frac{3}{4}$ to $4\frac{1}{4}$, of caudal fin 6 to 7, height of body $3\frac{1}{4}$ to $3\frac{1}{2}$ in the total length. *Eye*—small, lateral, rather in front of the middle of the length of the head, and $2\frac{1}{2}$ diameters apart. Head large, superiorly somewhat depressed, its greatest width equalling its length: body anteriorly thick, posteriorly much compressed. Snout broad: mouth anterior and wide, the maxilla reaching posteriorly nearly to or quite beneath the front edge of the eye: the upper jaw slightly the longer. Gill-opening, a rather short vertical slit, extending to the upper part of the base of the pectoral fin. Nostrils patent, the posterior nearer the eye than to the upper lip. *Teeth*—very small, disposed in both jaws in transversely oblique rows: none on vomer, palatine bones, nor on the tongue, which last organ is very thick. *Fins*—the dorsal commences above the middle of the pectoral, at first low, it increases in height

posteriorly, where it scarcely joins the base of the caudal. Pectorals reach the base of the anal fin in some but not in all examples, they are very broad, extending downwards and forwards under the throat, the lower five rays rather elongated, occasioning the fin to appear notched. Ventrals, each has six rays surrounding the disc, which has 13 soft and flat papillæ, while it is as broad as long, equalling nearly half the length of the head. Anal commences beneath the sixth or seventh dorsal ray, it is scarcely so high as the dorsal, while its last ray is connected with the base of the caudal fin: the latter is cut square. Vent midway between the posterior extremity of the disc and the commencement of the anal fin. Skin very loose even on the fins. Cœcal appendages rather long, 16 in number. *Colours*—purplish or yellowish brown with numerous small dark spots. Dorsal and anal fins yellow, dotted with black: pectoral yellow, its upper portion also black dotted. Caudal with three or more vertical bands of black spots, the one nearest the base of the tail being usually the widest.

Varieties.—Collett, Christ. Vid. Selsk. Forh. 1879, No. 1, p. 37, gives a very full account of the local varieties in this species. (1) *Principalis* being *L Montagui*, Malm. (2) *maculatus* or *L. maculatus*, Malm. (3) *annulatus*, (4) *striatus*, *L. lineatus* and *L. vulgaris*, Malm. (5) *pictus*, (6) *obscurus*, (7) *liparoides* or *Cyclopterus liparoides*, Nilss. (8) *Ekstromi* or *L. Ekstromi*, Malm.

Names.—Diminutive lump-sucker.

Habits.—A comparatively active fish, and rarely uses its sucker unless in a stream or when it appears likely to be pushed aside, while it is not often captured at a depth exceeding four or five fathoms, and during the spring and summer may be found under stones exposed by a receding tide. McIntosh, of St. Andrew's, says it is abundant in rock pools in the Laminarian region, and in deeper water, as in the stomach of the cod and haddock. L. Lester (Zool. 1855) observes on one he took in Dorsetshire that it attached itself both to the wood of a pail, and to the sides of a glass bottle. I found in one, two whole and portions of three other shrimps. They are not unfrequently taken adhering to sea-weed, *Fuci*, and sand-hoppers have been found in their stomachs. Placed in a globe of sea-water they at once attach themselves to it.

Breeding.—I received three fine examples and a small one from Brighton at the commencement of March, 1880, the largest was 5 inches in length, all were females with the ova fully developed: I have likewise observed them full of ova in April: large eggs and small ones are present at the same time. Couch and others have stated that the females are larger than the males: while Putman remarks that in American examples the latter have the first six dorsal rays prolonged and fleshy (Pro. Am. Ass. 1874, p. 335). Couch observes that in examples, he considered the male, he had found the dorsal fin expanded at its termination, but in the females wider at the middle and narrow behind.

Habitat.—This species has been recorded from Spitzbergen and the White Sea, as far north as 70° N. lat. It, however, appears to be more numerous as we proceed to temperate climates than is the *Liparis vulgaris*. In America it extends from the Polar regions to Cape Cod.

Discovered by Colonel Montagu at Milton, on the south coast of Devonshire, it unfortunately in this country has generally been considered a diminutive form, whereas it attains a size almost equalling that of the *sea-snail*. In the Orkneys and Shetland Isles an example upwards of 3 inches in length was taken by Mr. Syme in the winter of 1850-51 (W. Baikie): Edward has met with it at Banff, Sim at Aberdeen, Peach at Wick. Johnston observes it has been found at Berwickshire, where he considered it rare: Lowe states it to be common in the estuaries of Norfolk, and to have been several times taken in the river opposite Lynn in fresh waters at low tides. It is common off the mouth of the Thames, also along the south coast as far as Devonshire and Cornwall, in which last county, however, it is not abundant. It is also found in the Channel Islands.

In Ireland, according to Thompson, it is taken all round the coast.

Seventh Group—Acanthopterygii Gobiesociformes.

A single spineless dorsal fin consisting of few or a moderate number of rays: it and the anal are situated in the caudal portion of the body. Ventrals subjugular, with an adhesive apparatus between them. Body scaleless.

Family, XX—GOBIESOCIDÆ, *Bleeker.*

Branchiostegals five or six: pseudobranchiæ rudimentary. Gills three and a half. Body elongated, anteriorly depressed. Eyes lateral. Teeth conical or compressed. A single spineless dorsal fin, consisting of a few or a moderate number of rays, both it and the short anal are situated in the caudal portion of the body. Ventrals subjugular, placed wide asunder, consisting of one spine and four or five rays separated by an adhesive disc. Scales absent. Air-bladder absent. No pyloric appendages.

These small littoral forms are distributed from the shores of Northern Europe, through the temperate regions of both hemispheres, while some are present within the tropics. They are mostly found between high and low water mark, where they firmly attach themselves to rocks, stones or stationary objects. The adhesive disc is not similar to the same organ in *Cyclopterus* and *Liparis*, as instead of the ventral fins forming its groundwork they are placed wide asunder, the disc being between them, and only the under surface of some of their rays constituting a small portion of the entire circumference of the organ.

Genus I.—Lepadogaster, *Gouan.*

Mirbelia, Canestrini. *Gobiesox*, Lacép.

Branchiostegals five or six: pseudobranchiæ rudimentary. Anterior portion of the body and snout broad and depressed. Gill openings of moderate width: the gill membranes attached to the isthmus. Teeth pointed. Ventrals, dorsal and anal fins as defined in the Family, the two last may be either confluent with or distinct from the caudal fin. Scales absent. Air-bladder and pyloric appendages absent.

The genus *Mirbelia* was instituted for the reception of forms in which the vertical fins were not continuous.

Geographical distribution.—From the shores of Scandinavia to the British Isles and Madeira, also along the coast of France to the Mediterranean.

Remarking upon the habits of one species, Mr. Gosse (Tenby, p. 181) observes that "It is the habit of this tiny fish to lay its eggs in the interior of old shells of bivalves that lie on the bottom: and it would appear that it is one of those species which exercise a parental care over their offspring, watching the eggs until the young are hatched. We can scarcely call it incubation: but the little animal coils itself up among its spawn, adhering by the sucking disc of its belly to the interior of the shell, and continuing there with remarkable pertinacity. I have kept my specimen now for seven days, during the whole of which time I do not believe it has left the old cockle shell even for a minute . . . the embryos continue to be matured from day to day."

There can be no doubt but that the species included in this genus have been

rather mixed up one with another by the various British authors. There appear to be only three specific forms, and these are subject to almost endless modifications as to colour. They may be recognized as follows :

A. *Dorsal fin continuous with the caudal.*
  a. Dorsal fin with more than ten rays, *L. Gouanii.*

B. *Dorsal fin not continued on to the caudal.*
  a. Dorsal fin with more than ten rays (14-16), *L. Decandolii.*
  b. Dorsal fin with less than eight rays (5-7), *L. bimaculatus.*

A. *Dorsal and anal fins continuous with the caudal.*

1. **Lepadogaster Gouanii,** Plate LVII, fig. 1.

Small suck-fish, Borlase, Cornwall, p. 269, pl. xxv, f. 28, 29. *Le Barbier ou Porte-Ecuelle*, Gouan, Hist. Pisc. t. i, f. 6, 7. *Jura sucker*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 137, pl. xxii (Ed. 1812) iii, p. 181, pl. xxv; Couch, Trans. Linn. Soc. xiv, p. 87.

Lepadogaster rostratus, Bl. Schn. p. 1; White, Catal. Fish. p. 108.

Lepadogaster Gouanii, Lacép. i, pl. xxiii, f. 3, 4 and ii, p. 73; Risso, Ich. Nice, p. 72 and Eur. Mérid. iii, p. 271; Costa, Fauna Napol. Pesc. p. 2, t. xxiii, f. 1-3; Cuv. Règ. Anim. Illus. Poiss. pl. cviii, f. 2; Kröyer, Dan. Fisk. ii, p. 538; Günther, Catal. iii, p. 510; Canestr. Arch. Zool. Anat. Maggio, 1864, iii, p. 183; Steind. Ich. Span. u. Port. 1868, p. 20; Giglioli, Pesc. Ital. p. 33; Moreau, Poiss. France, iii, p. 356.

Cyclopterus spatula, Lacép. ii, p. 68.

Cyclopterus ocellatus, Donovan, Brit. Fish. iv, pl. lxxvi; Turton, Brit. Fauna, p. 116.

Cyclopterus lepadogaster, Webb, Artedi, vii, p. 490; Bonnaterre, Enc. Ich. p. 29, pl. lxxxvi, f. 356.

Cyclopterus Cornubicus, Shaw, Zool. v, p. 397; Swainson, Fishes, ii, p. 338.

Lepadogaster ciliatus, Risso, Journ. Phy. xci, p. 248.

Lepadogaster balbis, Risso, Ich. Nice, p. 73, pl. iv, f. 9 and Eur. Mérid. iii, p. 274; Cuv. Règne Anim.; Costa, l. c. t. xxii.

Lepadogaster biciliatus, Risso, Eur. Mérid. iii, p. 272; Nord. in Demid. Voy. Russ. Mérid. iii, p. 537, pl. xv, f. 4-6.

Lepadogaster Cornubiensis, Flem. Brit. Anim. p. 189; Yarrell, Brit. Fishes (Ed. 1) ii, p. 264, c. fig. (Ed. 2) ii, p. 359 (Ed. 3) ii, p. 335; Jenyns, Brit. Vert. p. 469; Thompson, Proc. Z. Soc. 1835, p. 81 and Nat. Hist. Ireland, iv, p. 212.

Lepadogaster zebrinus, Lowe, Proc. Zool. Soc. vii, 1839, p. 88.

Lepadogaster Webbianus, Val. in Webb and Berthel. Iles Canar. Poiss. p. 85.

Cornish sucker, Couch, Brit. Fishes, ii, p. 196, pl. cviii, f. 2.

B. v-vi, D. 16-20, P. 20-25, V. 1/4, A. 9-11, C. 19.

Length of head $2\frac{1}{3}$ to $2\frac{3}{4}$, of caudal fin 6, height of body 5 to 6 in the total length. *Eye*—7 to 8 diameters in the length of the head, $1\frac{1}{2}$ to 2 diameters from the end of the snout, and $1\frac{1}{2}$ apart. Body anteriorly broad and depressed, but compressed posterior to the termination of the disc. The width of the head at the occiput equals twice its height: lower surface flat. Snout spatulate, and has been aptly likened to the bill of a duck: upper jaw slightly the longer: the maxilla reaches to beneath the middle of the orbit. Nostrils close together, the posterior tubular, the anterior with a well-developed tentacle equalling about one diameter of the orbit in length. *Teeth*—in a patch of villiform ones at the anterior portion of either jaw, while laterally they form a single row of larger ones, which are conical and somewhat curved backwards. *Fins*—the dorsal commences about midway between the front edge of the eye and the posterior extremity of the caudal fin, on to which latter both it and the anal are continued. Caudal wedge shaped or rounded. Pectoral with a broad base and having a membraneous connection with the inner ray of the ventral.

Ventral consists of one badly developed spine imbedded in the skin, and four rays, the inner of which is connected with the lowest of the pectoral. Between the ventral fins and extending posteriorly to the middle of the length of the fish exists a large suctorial disc which is composed of two portions separated one from the other by a deep groove. The entire organ can be employed as one sucker, the skin covering the outer but inferior margin of which, is modified into irregularly shaped flattened points, extending on to the under surface of the three outer ventral rays, which thus constitute a portion of the disc. As already observed, the large disc is subdivided into two, the anterior being connected with the base of the ventral fins but separated by a deep transverse groove from the posterior portion of the disc. The ventral portion extends anteriorly towards the throat, where it is formed by two layers of skin passing from the base of one ventral fin to the other, the inner or lower layer having a thickened pavement-like appearance as already described, and which is continued on to the three outer ventral rays; the centre of this portion is a smooth pad. The posterior portion of the disc has for its groundwork cartilaginous expansions from the radius (Owen or coracoid, Parker), its centre is a soft smooth pad similar to that observed in the anterior portion, while the whole of its circumference, is formed of two layers of skin forming a free edge: the lower layer being thickened and modified into flattened nodules as already described, and just at its posterior margin fine ray-like prolongations of the cartilage are visible. Skin slightly loose but tough. *Colours*—usually carmine or purplish red, becoming lighter on the under surface. In some, however, the ground colour is brown or green. Two or three yellow dark-edged interorbital bands are usually present: and two large oval, sometimes pyriform, black ocelli on the occiput surrounded by two lighter rings. Some have oblique blue stripes on the body. Risso observes that no external differences are perceptible between the males and the females.

Varieties.—The colours widely differ, occasioning some authors to constitute several different species. *L. Gouanii*, Risso, is greenish with dark spots, but no blue markings. *L. balbis*, Risso, has two dark red spots on the side of the neck. *L. biciliatus*, Risso, is green with blue or brown spots and marks. *L. zebrinus*, Lowe, is blackish brown, the sides being posteriorly marked with oblique blue stripes: the neck having divergent cross streaks and a pair of pear-shaped blotches. In the Ordnance Survey of the county of Londonderry, two examples of a rich blue colour are alluded to, with deeper tinted postocular spots.

Names.—*Jura sucker* by Pennant, due to his having first obtained it at Jura in the Hebrides: *Cornish sucker*, owing to its being common in Cornwall.

Habits.—Resides under stones in pools between the tide marks, where it can firmly attach itself to stationary or suitable objects. It is inactive, its movements being a species of wriggle. Montagu remarked that although it is sluggish it seems to wander, sometimes being abundant, at other times rare. It is tenacious of life. Couch observes that its food is the smaller crustaceous and marine insects which it swallows whole.

Breeding.—About March or April, when it deposits its ova inside the dead shells of oysters, scollops, or other bivalves. Couch says the grains of ova are of considerable size in proportion to the bulk of the fish.

Habitat.—Extends from Denmark along the coasts of Great Britain, Ireland and France where it is common in some localities, to Spain, Portugal, Teneriffe, and Italy, where, however, it is not common. In fact it may be said to be rare in the Mediterranean. Orkney and Zetland, one example obtained in Scalpa Flow, in the winter of 1850, by Mr. J. Syme (W. Baikie), Jura in the Hebrides (Pennant). Aberdeen, where one local example is in the possession of Mr. Sim. Montagu considered it to be common at Milton, in Devonshire: Borlase obtained it in Cornwall, and Mr. Cornish observes that in Cornwall it is common under stones and in small pools by the sea shore. I have received it from Mr. Dunn of Mevagissey, and many examples from Mr. Carrington, F.L.S., which he collected in Guernsey.

In Ireland it has been recorded by Thompson from the north-east and west coasts. Coast of Clare (D. 20, A. 11, V. 4, P. 19, C. 14, B. vi) two filaments before each eye and a third fleshy appendage placed nearer to the eye and unconnected with the others. Several examples from Portrush, Oct. 1837, colour of a rich blue, the spots between the eyes of a deeper tint: Lahinch, county Clare two examples, July, 1840, between tide marks. August, 1845, several full-grown examples under stones between tide marks, at Tory Island, off Donegal.

The example figured life size was one of those received from Guernsey. This fish attains to at least 4 inches in length.

B. *Dorsal fin not continued on to the caudal.*

2. **Lepadogaster Decandolii**, Plate LVII, fig. 2.

Lepadogaster olivaceus, Risso, Ich. Nice, p. 75 and Eur. Mérid. iii, p. 274.

Lepadogaster Decandolii, Risso, Ich. Nice, p. 76 and Eur. Mérid. iii, p. 275; Cuv. Règ. Anim.; Bris. de Barnev. Rev. Zool. 1846, p. 281; Steind. Ich. Span. u. Port. 1868, p. 20.

Lepadogaster Jussieui, Risso, Europ. Mérid. iii, p. 273.

Lepadogaster cephalus, Thompson, Ann. and Mag. Nat. Hist. iii, p. 34 and Nat. Hist. Ireland, iv, p. 214; Yarrell, Brit. Fishes (Ed. 3) ii, p. 341.

Lepadogaster Rafinesqui, Costa, Faun. Nap. t. xxiv, f. 1-3.

Lepadogaster adhærens, Bonap. Catal. 65.

Connemara sucker, Couch, Fish. Brit. Isles, ii, p. 201, pl. cix.

Lepadogaster condollii, Günther, Catal. iii. p. 513; Moreau, Poiss. France, iii. p. 360.

Mirbelia Decandolli, Canest. Arch. Zool. Anat. Maggio, iii, p. 189; Giglioli, Pesc. Ital. p. 33.

B. vi, D. 14-16, P. 25, V. 1/4, A. 8-11, C. 18.

Length of head $2\frac{3}{4}$ to 3, of caudal fin $5\frac{1}{2}$, height of body 6 in the total length. *Eye*—diameter about 6 in the length of the head, 1 to $1\frac{1}{2}$ diameters from the end of the snout, and slightly more apart. Body broad and compressed anteriorly, but compressed in its last half. The width of the head at the occiput equals twice its height. Snout somewhat spatulate, the upper jaw the longer. The maxilla reaches to beneath the first third of the orbit. Nostrils near together, both slightly tubular, the anterior most so. *Teeth*—in a patch of villiform ones at the anterior portion of each jaw, while laterally they are in a single row of larger and more separated conical ones. *Fins*—the dorsal commences about midway between the front edge of the eye and the hind extremity of the caudal fin: its posterior rays are higher than its anterior ones, while a membrane passes from its last ray nearly to the base of the caudal fin: the anal which commences beneath the commencement of the second third of the dorsal has a similar membrane from its last ray to nearly the base of the caudal: the latter fin is rounded at its extremity. Pectoral with a broad base, it and the ventral similar to what has been described under *L. Gouanii*. Skin rather looser than in *L. Gouanii*. *Colour*—red with carmine fins: body with numerous oval and rather large light spots, some round ones on the fins. Some examples have a dark ocellus on the side of the head behind the eye.

Varieties.—This species, which is said to be sometimes nearly red, is apparently subject to considerable variation in colour.

Name.—*Connemara sucker*, owing to its having been first recorded as British from that portion of Ireland.

Habits.—Resembling those of the other species of the Genus.

Means of capture.—Under stones situated between high and low water mark.

Habitat.—Coasts of Ireland, Cornwall, the Channel Islands, and France to the Mediterranean, where it is common. Couch observed that only a few examples

had fallen into his hands, rendering it likely that the species is limited to particular districts. I have received several from Mr. Carrington, F.L.S., taken at Guernsey: one of which is figured life-size.

In Ireland one example $2\frac{1}{2}$ inches long has been captured at Connemara on the west coast.

3. **Lepadogaster bimaculatus,** Plate LVII, fig. 3 ($\frac{2}{1}$).

Bimaculated sucker, Pennant, Brit. Zool. (Ed. 1776) p. 397, pl. xxii (Ed. 1812) p. 182, pl. xxv: Montagu, Trans. Linn. Soc. vii, p. 293 and Wern. Mem. p. 92.

Cyclopterus bimaculatus, Donov. Brit. Fish. iv, pl. lxxviii; Walb. Artedi, iii, p. 490; Bonn. Ency. Ich. p. 29, pl. lxxxvi, f. 355; Bl. Schn. p. 199; Lacép. ii, p. 67; Turton, Brit. Fauna, p. 115.

Gobiesox bimaculatus, Cuv. Règne Anim.; Swainson, Fishes, ii, p. 339; White, Catal. Fish. p. 108.

Lepadogaster bimaculatus, Flem. Brit. Anim. p. 190; Yarrell, Brit. Fishes (Ed. 1) ii, p. 268, c. fig. (Ed. 2) ii, p. 363 (Ed. 3) ii, p. 339; Nilss. Skan. Faun. p. 241; Düben en Koren, Vet. Akad. Handl. 1844, p. 109, t. iii, f. 7; Flem. Brit. An. p. 190; Jenyns, Brit. Vert. p. 470; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 412; Barnev. Rev. Zool. 1846, p. 282; Nilss. Skand. Faun. Fisk. p. 241; Thompson, Pro. Zool. Soc. 1835, p. 82 and Nat. Hist. Ireland, iv, p. 212; Günther, Catal. iii, p. 514; McIntosh, Fish. N. Uist, P. Roy. Soc. Edin. V. 1862-66, p. 614 and Fish. St. Andrews, p. 177; Steind. Ich. Span. u. Port. 1868, p. 20; Collett, Norges Fiske, p. 90; Moreau, Poiss. France, iii, p. 361.

Lepadogaster ocellatus, Risso, Ich. Nice, p. 74.

Lepadogaster reticulatus, Risso, Ich. Nice, p. 77 and Eur. Mérid. iii, p. 277.

Lepadogaster mirbelia, Risso, Journ. Phy. xci, p. 249 and Eur. Mérid. iii, p. 277.

Lepadogaster Desfontanii, Risso, Eur. Mérid. iii, p. 275, f. 39; Nardo, An. Ven. 79.

Lepadogaster lineatus, *maculatus*, and *punctatus*, Guichen. Explor. Sc. Algér. Poiss. p. 110, pl. vi, f. 3.

Mirbelia Desfontanii, Canest. Arch. Zool. Anal. Maggio, 1864, iii, p. 192.

Mirbelia bimaculata, Giglioli, Pesc. Ital. p. 33.

Doubly spotted sucker, Couch, Fishes of the British Isles, ii, p. 198, pl. cviii, f. 1.

B. vi, D. 5-7, P. 17, V. 5, A. 4-6, C. 12.

Length of head $2\frac{3}{4}$ to $3\frac{1}{2}$, of caudal fin $6\frac{3}{4}$, height of body 6 to 8 in the total length. *Eyes*—$5\frac{1}{2}$ diameters in the length of the head, $1\frac{1}{4}$ to $1\frac{1}{2}$ diameters from the end of the snout, and $1\frac{1}{2}$ apart. The posterior nostril close to the eye and patent, the anterior more tubular. Greatest width of the head 2/3 its length. Body widest anteriorly, flattened below, snout depressed, spatulate. Upper jaw the longer, the posterior extremity of the maxilla reaches to beneath the middle of the orbit. *Teeth*—a single row along the lateral ramus of either jaw, those in the lower being rather widely separated: a patch of villiform teeth anteriorly. *Fins*—the dorsal commences about midway between the posterior extremity of the head and the end of the caudal fin, posteriorly it is not continued nearly to the caudal. The lower rays of the pectoral are not conjoined to those of the ventral. Anal commences on a line somewhat posterior to the origin of the dorsal, and does not reach nearly so far posteriorly as to the base of the caudal, which is rounded or wedge-shaped. The suctorial disc is very similar to that already described under *L. Gouanii*. *Colours*—reddish, tinged with orange, some reddish bands on the head in a V-shape pointing backwards. A black, or dark purple, light-edged ocellus just behind the end of the pectoral fin. Body somewhat banded, as is also the caudal fin.

Varieties.—The black ocellus on the side of the body has been observed to be sometimes absent, especially in the young. Its colours are subject to great

differences. *L. lineatus*, Guichenot, being green with a pearly white band from the eye to the tail, from which five cross bars pass towards the back. *L. maculatus* is brown with three large red spots on the back. *L. punctatus* is green, with three longitudinal brown stripes on the snout, and reddish dots on the body.

Names.—*Bimaculated* and *doubly-spotted sucker*, due to the black ocellus on either side, situated near the posterior end of the pectoral fin.

Habits.—Adults live in deeper water than the *L. Gouanii:* smaller ones are mostly found nearer low water-mark at spring tides than at any other spot. On being removed from the water they immediately attach themselves to the captor's hand.

Means of capture.—Dredging, found under stones, or, according to Couch, drawn up in crab-pots, the larger individuals keeping in deep water: he records how one was rejected from the mouth of a fish which was being hooked at a depth of thirty-eight fathoms. Mr. Hughes, Zool. 1864, p. 9131, gives an account of this fish in an aquarium, it is of roving habits but soon accommodates itself to its new home. Its colours change, dependent perhaps upon the emotions of the fish, from yellowish white to a rich carnation hue. Its eyes are its especial beauty, resembling living opals set in burnished gold. It is able to attach itself firmly to stones, old shells, or other substances. It speedily fixes itself to some untenanted bivalve shells, sometimes remaining for days without moving, except that it would frequently turn round in the shell with a smooth gliding motion, especially when anyone went near the aquarium. It is most restless during the night, but its locomotive powers appear to consist in shifting from one stationary position to another; it therefore appears to be deficient in the power of pursuing prey, but while at anchor it maintains a constant and regular fanning with its silvery pectoral fins. Possessing no air-bladder it swims with difficulty by means of its fins and tail; and drops, when so desirous, to the bottom by means of its specific gravity as soon as these cease motion. It eats bits of mussel, oyster, or small fish.

Breeding.—Mr. Hyndman dredging, June 20th, 1844, off St. John's Point, co. Down, brought up from fifteen fathoms an adult, and a perfect *Venus virginea*, in which was one of these fish with its ova and young, some only of which had made their appearance. At the end of August, in Belfast Bay, he dredged a single full-grown valve of *Pectunculus pilosus*, the hollow of which was closely studded over for the space of a square inch with the ova of this fish, each of which is globular and about 1/16 of an inch in diameter. Thompson continues that he has frequently seen this species dredged in old single valves of bivalve shells, but before Mr. Hyndman's discovery he was not aware of why they were partial to them.

Habitat.—From Scandinavia to the British Isles, the shores of France to those of the Iberian peninsula, becoming rare in the Mediterranean, but extending to Algeria and Italy. In the Orkneys and Zetland it is not rare (W. Baikie). In Scotland one dredged in Loch Ryan was brought to Belfast market. Edward in Banffshire once took a fish he thinks may be this species. At Lossiemouth, Moray Firth, an example 1½ inches long (Weir, 1852) attached to a shell was drawn up by a fisherman's line. An example was taken at Blakeney, in Norfolk, in July, 1846 (Lowe, Fauna, p. 15). Donovan obtained it in Kent. At Weymouth it was first recorded by the Duchess of Portland: Gosse states that during the summer it is frequently dredged there: and Montagu observed that it was not very uncommon in Devonshire; while although found in Cornwall it does not appear to be so common as *L. Gouanii*. Mr. Carrington, F.L.S., obtained it for me from Guernsey.

Ireland.—Has been taken on the north-east, east, and west of the island. One dredged off Bangor, county Down, September 3rd, 1834, in 5 or 6 fathoms (no spots, P. 18), 1 inch 10 lines long. One, Strangford Lough, October, 1834, in 5 or 6 fathoms, 1 inch 5 lines long: colours reddish orange, with round spots and irregular white markings. One had large blotches of pale vermillion along its back. Templeton dredged two examples, August, 1811. Not uncommon in Belfast Bay and Strangford Lough. Also taken at Larne.

The example figured was sent to me by Mr. Dunn from Mevagissey. It is drawn twice the natural size. This form attains to at least 2 inches in length.

Eighth Group—Acanthopterygii Blenniformes.

Body elongated, sub-cylindrical or compressed. Dorsal fin many rayed, occasionally composed entirely of spines, or the articulated part may be nearly or quite as long as, or even longer than, the spinous portion. Ventrals, if present, thoracic or jugular. Anal of varying length. Caudal present or absent.

This division comprises two families of which genera have been obtained in Great Britain. (1) *Blenniidæ* having a rather elongated body: and ventrals when present jugular. (2) *Cepolidæ*, body very elongated: ventrals thoracic.

Family, XXI—BLENNIIDÆ, *Swainson.*

Pseudobranchiæ mostly present. Body elongated, more or less cylindrical. Teeth may be fixed in the jaws or merely implanted in the gums: a posterior canine may be present: while some genera have molars. One, two, or three dorsal fins, nearly occupying the entire length of the back. Ventrals, when present, sometimes rudimentary, usually jugular. Anal with a moderate or large number of articulated rays. Caudal, when present, may be confluent with, or distinct from, the vertical fins. Scales, when present, usually small. Air-bladder and pyloric appendages generally absent.

The fishes which constitute this family are mostly littoral forms distributed throughout the greater portion of the temperate and tropical regions, some extending their range into brackish or even, it is said, into fresh waters.

The British forms belonging to this family appertain to the following genera:—

1. *Anarrhichas.* Strong conical teeth in the front of the jaws: two rows of large molars on the palate. No ventral fins. Scales rudimentary.
2. *Blennius.* A single row of teeth in the jaws, in some likewise a curved posterior canine. Ventral fins present. Scales absent.
3. *Carelophus.* Small teeth in jaws. Dorsal fin consisting only of spines. Ventrals jugular. Scales present.
4. *Centronotus.* Minute teeth in jaws. Dorsal fin consisting only of spines. Ventrals rudimentary if present. Scales absent.
5. *Zoarces.* Conical teeth in jaws. A depressed portion of the dorsal fin composed of spines. Ventrals rudimentary. Caudal fin absent. No scales.

Genus I.—Anarrhichas, *Artedi.*

Branchiostegals seven: pseudobranchiæ present. Body elongated: head large: snout obtuse: cleft of mouth deep. Gill-openings wide. Teeth conical anteriorly with pointed tubercles laterally, and in two rows of molarform ones on the palate. A single long dorsal fin, consisting of flexible spines, and not continued on to the caudal. Ventrals absent. Caudal distinct from the dorsal and anal fins. Scales on body rudimentary. Air-bladder and pyloric appendages absent.

Gesner originally designated this fish *Anarrhichas*, derived from the Greek term signifying "to climb," as the people on the shores of the Baltic believed that it climbed on to the rocks. It was placed by Cuvier among the Blennies, being a gigantic form of the family: Gill, however, considers it the type

of a distinct family. Its powerful jaws and teeth were remarked on by Hunter, who observed that the mouth of the wolf-fish is almost paved with teeth, by means of which it can break shells to pieces, and fit them for the œsophagus of the fish, and so effectually disengage the food from them, that though it lives on such hard food, the stomach does not differ from that of other fish.

This genus is well represented in the northern seas of both hemispheres, extending in Europe southwards to the British coast, while it has a somewhat similar extension in the American seas.

1. Anarrhichas lupus, Plate LVIII.

Anarrhichas, Gesner, Nomen. Aq. Anim. p. 116 and Paralip. p. 4; Artedi, Gen. p. 23; Olear. Gott. Kuns. t. xxvii, f. 2. *Zee-Wolf*, Gronov. Zooph. No. 400 and Mus. Ich. No. 44. *Lupus marinus*, Schonev. p. 45, t. v; Jonston, t. xlvii, f. 2; Will. p. 130, t. H 3, f. 1; Ray, p. 40. *Latargus*, Klein, Pisc. Miss. iv, p. 16. *Anarrhichas non maculatus*, Olafs. Reise, § 683*a*. *Anarrhichas minor*, Olafs. Isl. Reise, § 683*b*, t. xlii; Müll. Prod. Dan. p. 40; Fabr. Faun. Grönl. p. 139, No. 97*b*; Mohr. Isl. Nat. Hist. p. 64, No. 115; Gmel. Linn. i, p. 1143; Bl. Schn. p. 496; Ascan. Icon. t. xxv. *Steen-bider*, Pontopp. Norg. Nat. Hist. ii, p. 243; Ström. Söndm. i, p. 310. *Ravenous wolf-fish*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 151, pl. xxiv (Ed. 1812) iii, p. 201, pl. xxvii. *Cat-fish*, Sibbald, Scot. Illus. iii, p. 25, t. xvi.

Anarrhichas lupus, Linn. Syst. i, p. 430; Shaw, Zool. iv, p. 93, pl. xiii; Olavii, Reise, i, p. 80; Retz. Faun. Suec. p. 315; Fabr. Faun. Grönl. p. 138, No. 97; Mohr. Isl. Nat. Hist. p. 63, No. 114; André, Phil. Trans. Roy. Soc. 1784, p. 274, t. xi; Brouss. Mém. Acad. Sc. 1785, p. 161, pl. iii; Müll. Prod. Zool. Dan. p. 40; Bonnaterre, Atl. Ich. p. 38, pl. xxvi, f. 87; Gmel. Linn. i, p. 1142; Bl. iii, p. 25, t. lxxiv; Bl. Schn. p. 495; Lacép. ii, pp. 299, 300, pl. ix, f. 2; Low, Faun. Orcad. p. 187; Cuv. Règ. Anim. Ill. Poiss. pl. lxxix, f. 2; Faber, Fische Isl. p. 70; Donov. Brit. Fish. i, pl. xxiv; Turton, Brit. Faun. p. 87; Fleming, Brit. Anim. p. 208; Fries och Ekstr. Skand. Fisk. p. 23, t. viii, f. 2; Richards. Faun. Bor. Amer. p. 95; Jenyns, Man. p. 384; Yarrell, Brit. Fish. (Ed. 1) i, p. 247, c. fig. (Ed. 2) i, p. 277 (Ed. 3) ii, p. 384; Parnell, Wern. Mem. vii, p. 339; Cuv. and Val. xi, p. 473, pl. cccxli; Gaim. Voy. Isl. and Grönl. &c. pl. iv; Thompson, Proc. Zool. Soc. 1835, p. 80; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Johnston, Berwick. Nat. Club. 1838, i, p. 172; Swainson, Fishes, ii, p. 283; Gronov. ed. Gray, p. 188; Gaim. Voy. Scand. &c. pl. xii, f. 2; De Kay, New York Fauna, Fishes, p. 158, pl. xvi, f. 43; Nilss. Skand. Faun. iv, p. 208; Thompson, N. H. Ireland, iv, p. 111; White, Catal. Brit. Fish. p. 50; Günther, Catal. iii, p. 208; Schlegel, Dieren Neder. p. 67, pl. vi, f. 5; Collett, Norges Fiske, p. 70; Steenstrup, Vid. Medd. 1876, p. 159, pl. iii; McIntosh, Fish. St. Andrew's, p. 175; Winther, Ich. Dan. Mar. p. 22; Moreau, Poiss. France, ii, p. 159.

Anarrhichas strigosus, Gmel. Linn. i, p. 1144.

Anarrhichas pantherinus, Zouiew, N. Act. Petroph. 1781, p. 271, t. b; Gmel. Linn. i, p. 1144; Bl. Schn. p. 495, t. xcii; Lacép. ii, pp. 299, 309, 310.

Anarrhichas maculatus. Bl. Schn. p. 496.

Anarrhichas karrak, Lacép. ii, pp. 299, 307.

Wolf-fish, Couch, Fish. Brit. Isles, ii, p. 242, pl. cxvii.

B. vii, D. 72-74, P. 19, A. 45-46, C. 15-18, Vert. 26/50.

Length of head $4\frac{1}{2}$ to 5, of caudal fin $10\frac{1}{2}$, height of body $4\frac{1}{3}$ to 5 in the total length. *Eye*—near the upper edge of the head, 1 to $1\frac{1}{2}$ diameters from the end of the snout, and from 1/2 to 1 apart. Body elongated and compressed. Cheeks swollen. Anterior profile of the head very steep: snout short: cleft of mouth oblique, the posterior extremity of the maxilla reaching to beyond the hind edge of the eye. The masseter muscles very powerful. *Teeth*—differ considerably from those of any other British fish: in the upper jaw there are anteriorly four large canines in the pre-maxillaries, and six or eight smaller but conical ones. In the lower jaw two or three large, diverging, curved and conical canines, and behind them two smaller ones: laterally are two rows of molars

which posteriorly merge into one. Vomer with a double row of large molars. On the palatines are also two rows, the outer from four to six, being conical: and the inner, from two to four in number, being tuberculated at their summits. *Fins*—the dorsal commences at the nape and is continued almost as far as to the base of the caudal fin, its anterior rays are rather short, gradually increasing in length to opposite the commencement of the anal, the last ten or twelve rays gradually decrease in height. Pectoral with a broad base, it scarcely extends so far as to above the vent. Anal commences below about the thirtieth dorsal ray, and is continued almost to the root of the caudal fin. Caudal rounded posteriorly. *Skin*—having rudimentary and not imbricated scales, which are concealed to a great extent by the large amount of mucus that covers the body. Numerous open pores on the head disposed in rows. *Colours*—grayish brown, darkest along the back: a series of darker vertical bands, nearly as wide as the ground colour, pass down the sides to a little beneath the lateral-line. Numerous small black points exist over the body. Dorsal and anal fins yellowish, with narrow and oblique brown bands passing backwards. Pectoral and caudal gray.

Varieties.—*A. strigosus* was a term instituted by Gmelin for the banded examples, but it is probable that when fresh they are always banded, although Pennant remarks that in different fish these stripes have different appearances. Müller mentions a variety as "*Anarrhichas lupus non maculatus.*"

Names.—*Wolf-fish* or *sea-wolf*, owing to its ravenous propensities. In Orkney it is termed *swine-fish*, due to a sort of muscular motion of its nostrils, which the fishermen say resembles that in the nose of a swine (Lowe). *Wauffs* or *wuffs*, Yorkshire. *Sea-cat* or *Cat-fish* (Moray Firth) and Aberdeen (see *Zoarces viviparus*). *L'Anarrhique loup*, French. *Zee-wolf*, Dutch.

Habits.—It approaches the coast about May, and is a ravenous, fierce, and strong fish, which swims rapidly with a lateral undulating motion: when taken it fastens on anything within reach. Its jaws are so powerful that the Danes and Germans, under the idea that it can crush stones with its teeth, call it *Steenbider* and *Steinbeisser*. Its usual food is crustaceous animals and shell fish, including among the latter, mussels, scollops, large whelks, &c.; these it crushes and breaks to pieces with its teeth, and swallows the mass, the remains of the broken shells passing down the intestinal tract.

From the stomachs of these fish McIntosh has obtained at St. Andrew's, fragments of *Echinus esculentus*, *Buccinum undatum*, *Trochi*, *Nassa incrassata*, *Natica*, *Mya*, *Star-fishes*, *Stenorhynchus rostratus*, and *Galathea*.

Bowerbank found in the stomach of one, 3 feet 1 inch long, abundant remains of shells of a species of *Pecten* (Zool. p. 4886). Edward remarked that at Banff this fish was frequently found dead cast on shore after a storm, "which would seem to indicate that their habit is not always in deep water."

"One snapped a large stick with the greatest ease," An. and Mag. Nat. Hist. (2) 1853, xi, p. 465. A pair were taken, of different sizes, in a trawl, in the North Sea, about halfway between Grimsby and Norway. One of them bit at a mop handle, which was held out to it, so savagely that it was swung overboard without letting go its hold. When it was shaken off, one of its teeth was left behind it fastened in the wood. The fishermen in the Moray Firth say that it is more plentiful in March than at any other season, and that some of them are as big as any cod, and are good for eating (Gordon, Zool. 1852, p. 3460). It lives some time after removal from the water. It seems to prefer rocky coasts, keeping at the sea bottom.

Means of capture.—Baits or spearing, for which purpose the Norwegians were said to employ a trident. Parnell observed that it is common in all the rocky parts of the Firth of Forth, and often found on the haddock lines, and occasionally in the salmon nets above Queensferry. It also is sometimes taken in large deep sea nets, into which it has entered for the purpose of feeding upon the entangled fishes. Owing to its fierceness when captured the fishermen usually first beat out its front teeth and then knock it on the head.

Breeding.—According to Pennant it spawns in May and June, when it deposits

its ova upon the leaves of marine plants. The fry are of a greenish colour resembling the sea-wrack, among which they reside for some time after their birth. About June the young are said by Parnell to be 2 feet in length in the Firth of Forth.

Uses.—The Greenlanders were said to eat its flesh raw or salted, and make bags and other articles with its skin. But its hideous appearance and the sickly odour of its flesh renders it repulsive to the inhabitants of these islands, although fishermen occasionally eat it, having first cut off its head and then skinned it.

As food.—Lowe says "it is excellent eating; however, none are very fond of it, and generally reject it." At St. Andrew's a fisherman assured me that it was excellent eating. "It has so disagreeable and horrid an appearance that nobody at Scarborough," says Pennant, "except the fishermen will eat it, and they prefer it to holibut. They always before dressing take off the head and skin." Clarke (Fauna of Yorkshire) says the fishermen describe it as the best fish that swims, and Buckland found it on trial to be very good, and compared it to a nice veal chop. Donovan states that cooking having eradicated its unpleasant odour, he found its flavour was like, but superior to, that of the mackerel, and he deemed it delicious. De Kay says its flesh when smoked has somewhat the flavour of salmon.

Habitat.—Most abundant in the cold regions of the north, common in the German Ocean, becoming very rare off the French coast. On the eastern shores of America it is taken from Greenland to Cape Hatteras.

In Orkneys also Zetland (W. Baikie) "this very dreadful and ugly fish is often caught in our seas, and sometimes thrown ashore in storms. None of our fishermen love it, either hating the colour or the great teeth of which it can make good use, even when out of its own element" (Lowe). At Banff, frequent (Edward), also at Aberdeen (Sim): St. Andrew's, in deep water (McIntosh), Firth of Forth. In Yorkshire it is said to be common along the coast: Yarmouth (Paget), and East Norfolk coast (Gurney). Plymouth Sound but rare (Parfitt), it has been taken at Fowey and Looe in Cornwall (Couch).

Ireland.—Belfast, one example, April, 1807: one off Dublin Bay, January, 1839 (Jacob): two from Dingle (Ball): while some fish termed *Cat-ling* captured far out at sea off the Galway coast are supposed to be this species. Templeton remarked that it does not seem to be common on the coast but is sometimes met with in the Belfast market, most probably caught by the Carrickfergus fishermen in the bay. Thompson observes that it is occasionally taken on the east coast of Ireland.

It attains to 6 feet or even more in length.

Genus II.—Blennius, *Artedi.*

Icthyocoris, Bonap.; *Pholis*, Fleming; *Adonis*, Gray.

Branchiostegals six: pseudobranchiæ present. Body somewhat elongated and compressed: snout short. Cleft of mouth narrow. A tentacle often present above the orbit or on the nape. Teeth in a single row, fixed in the jaws: a posterior, curved tooth usually present in one or both jaws. Dorsal fin single, the spinous portion being less, or equally developed with the soft rays. Ventrals jugular, consisting of one spine and two rays. Caudal distinct. Scales absent. Air-bladder and pyloric appendages absent.

The generic name *Blennius* is derived from βλεννα, "mucus," which designates their slimy nature. All the articulated fin rays are unbranched, except those in the caudal, which are simply divided at their extremities. In some forms an occipital or infraorbital crest is a distinctive mark of the male sex.

Geographical distribution.—Blennies are found in the coasts of Europe, the tropical Atlantic, the Red Sea to Sind, rare in the Indian Ocean but present in Ceylon. Also in the North Pacific near the Sandwich Isles, and Van Dieman's Land in the South Pacific Ocean.

These fishes attach themselves to objects in the water: thus Sir Walter Elliot possessed a specimen pumped up on board the "Samarang," in the Bay of Bengal, April 6th, 1850, which must have attached itself to the vessel before leaving harbour, or been sucked up on some piece of floating substance on which it had drifted out to sea. Some species have been observed to attach themselves to floating sea-weed, which they make their temporary home. Among the rocks they appear to employ their pectoral and ventral fins for the purpose of crawling and moving about. *Blennius vulgaris* has been acclimatized in inland lakes of fresh water. *Blennius unicornis*, Castlenau (Proc. Linn. Soc. New S. Wales, 1879, iii, p. 384), is found to feed on oysters, while the common shanny will eat small mussels and other shells, the remains of which pass along the intestinal tract. Blennies possess very powerful jaws and are able to hold on by their teeth with great tenacity, as everyone practically acquainted with them well knows: and it is by means of such powerful organs that they can remove limpets and mussels from the rock when they require them for food.

These fishes can see with great distinctness either when the head is out of the water or else submerged: watching everything with vigilance and immediately retreating into crevices of the rocks or under sea-weed when the hand or any foreign object approaches them.

The British forms are four in number, and thus subdivided:—

A. *Orbital tentacle present.*

a. First dorsal fin not elevated.

1. *Blennius gattorugine*, D. 13/19-20, A. 21-22.
2. *Blennius galerita*, D. 12/17, A. 18.

b. First dorsal fin elevated.

3. *Blennius ocellaris*, D. 11/15, A. 18.

B. *Orbital tentacle absent.*

4. *Blennius pholis*, D. 12/19, A. 19.

1. Blennius gattorugine, Plate LIX, fig. 1.

Gattorugine, Willughby, p. 132, c. xx, t. H 2, fig. 2; Ray, p. 72; Pennant, Brit. Zool. (Ed. 1) iii, p. 207, pl. xxxv (Ed. 2) iii, p. 278, pl. xxxix. *Blennius*, sp. 2. Artedi, Genera, p. 26; Klein, Pisc. Miss. v, p. 32, t. vii, f. 1.

Blennius gattorugine, Bloch, t. clxvii, fig. 2; Bl. Schn. p. 168; Brünn. Pisc. Mass. p. 27; Shaw, Brit. Zool. iv, p. 168; Bonn. Atl. Ich. p. 54, t. xxxi, f. 114; Donovan, Brit. Fish. iv, pl. lxxxvi; Turton, p. 92; Lacép. ii, p. 468; Martens, Reise nach Venedig. ii, p. 418; Risso, Ich. Nice, p. 127 and Eur. Mérid. iii, p. 230; Cuv. and Val. xi, p. 200; Yarrell, Brit. Fish. (Ed. 1) i, p. 226, c. fig. (Ed. 2) i, p. 256 (Ed. 3) ii, p. 362; Fleming, Brit. An. p. 206; Jenyns, Man. p. 379; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 409; Guichen. Explor. Algér. Poiss. p. 69; Lowe, Trans. Zool. Soc. iii, p. 9; Thompson, Nat. Hist. Ireland, iv, p. 108; White, Catal. Brit. Fish. p. 47; Günther, Catal. iii, p. 212; Canestrini, Arch. Zool. 1862, ii, p. 90, t. ii, f. 1; Steind. Ich. Span. u. Port. 1868, p. 1; Vinciguerra, Blenn. Genova, Annal. Mus. Civ. Genova, xv, 1880, p. 433; Giglioli, Pesc. Ital. p. 30; Moreau, Poiss. France, ii, p. 121.

Blennius varus, Pall. Zoogr. Russ. iii, p. 170; Nord. in Demid. Voy. Russ. Mérid. iii, p. 402 (not Risso).

Gattorugine, Couch, Fish. Brit. Isles, ii, p. 219, pl. cxi.

B. vi, D. $\frac{12-14}{19-20}$, P. 14, V. 1/2-3, A. 21-22, C. 12-13, Vert. 12/27.

Length of head $4\frac{1}{2}$ to $4\frac{2}{3}$, of caudal fin 6 to $6\frac{1}{2}$, height of body $4\frac{1}{4}$ to 5 in the total length. *Eye*—situated high up, either in or rather before, or a little behind, the middle of the length of the head; from $1\frac{1}{4}$ to $1\frac{1}{2}$ diameters from the end of the snout, and 1/2 to 3/4 of a diameter apart. Interorbital space concave. Snout obtuse, with a very steep profile. Head compressed, a little longer than high. A well-developed fringed tentacle above the orbit, sometimes equalling in length the diameter of the eye, or even more:* valve at anterior nostril likewise fringed. The maxilla reaches to beneath the front edge of the eye: lips rather thick. *Teeth*—34 to 44 in the upper jaw, and a few less in the lower; the last on either side of the mandible curved backwards and inwards, but not enlarged. *Fins*—the dorsal commences above the base of the opercle, a slight notch exists between its spinous and soft portions, while posteriorly the last ray of the fin has a membraneous continuation to the base of the caudal: none of its rays are divided. Ventral short, its rays undivided. Anal with undivided rays, and not united with the caudal, the latter fin being nearly square at its extremity: its nine central rays divided. *Lateral-line*—curves to above the commencement of the anal fin. *Colours*—olive-gray or brown with blotches and wide vertical bands: a black spot beneath the eye; lower margins of the caudal and anal fins edged with white, and lower rays of pectoral and ventral stained with orange. A black spot frequently exists between the third and fourth dorsal spines.

Varieties.—In colours are very common, and in accordance with the locality which it resides in.

Names.—*Tompot* Cornwall, said to be probably derived from its being frequently taken in crab-pots. *Gattorugine* has been asserted by some to be a derivation from *gatto rusalo* its common name at Venice, alluding to the thickness of its throat, which frequently abbreviated to *gatto*, signifying "a cat," has given rise to the idea that the whole term might mean, rusty or red cat. *Le perce-pierre*, French.

Habits.—Inhabits deep water, and prefers rocky ground. It is very voracious, principally feeding on small crustaceans, bivalves, corallines: while even brown sea-weed has been found in its stomach. This species is rarely left on rocks by a receding tide, its residence being in the deeper water; but Couch remarks upon having procured two examples (plate cxiii, fig. 1), both of reddish colour, left by an ebbing tide, and concealed under a stone.

Means of capture.—Usually in a crab-pot, which has had some fine net placed along its floor: these fish which enter from the top or sides in order to eat the bait, appear always to leave by descending through the bottom. In Ireland it is said to be taken in lobster traps laid in 12 to 14 fathoms of water.

Bait.—In some localities it appears to be used as a bait for lobster and crab-

* *Blennius ruber*, Cuv. and Val. xi, p. 211, is said to differ from this species, in that its supraorbital tentacle is shorter, and its colour of a bright red. The same variation in colour has been observed in Cornwall.

pots; while, owing to the small size of its mouth and the localities it frequents, it is not often taken by line fishing.

Breeding.—End of May full of roe, which is of a mulberry or lead colour.

As food.—Lacépède asserts that they are good eating.

Habitat.—Atlantic coasts of Europe to the Canary Isles, extending through the Mediterranean and Adriatic, and also reported from the Black Sea.

In Banffshire it has been taken twice (Edward): five stuffed examples in the British Museum are said to have come from the Firth of Forth. Along the south coast it has been reported from Poole Harbour, Dorsetshire (Yarrell); also from Weymouth (Gosse), Devonshire (Montague), while it is common along the coast of Cornwall. It is found in Somersetshire, a local example existing in the Weston-super-Mare Museum; while it was first obtained off Anglesea by Pennant.

In Ireland it is taken on the north-east coast. Templeton (Mag. Nat. Hist. 1837 (2) i, p. 409) observed that on June 22nd, 1811, he received this little fish from Mr. McSkimmin, who informed him that he had procured it from the lobster traps of the Carrickfergus fishermen. Portrush, co. Antrim, not rare, here specimens were obtained up to 7 inches in length by J. Ogilby, in crab-pots laid on a rocky bottom, in 10 to 12 fathoms of water (Zool. 1876, p. 4753). Londonderry (Ordnance Survey).

The example figured is 8 inches in length, and came from Mevagissey, in Cornwall. It attains to at least 9 inches in length, and is the largest of the true British Blennies.

2. Blennius galerita, Plate LX, fig. 1.

Blennius, No. 4, Artedi, Genera, p. 27 (not synon.); *Alauda cristata sive Galerita*, Willugh. Hist. Pisc. p. 134; Ray, p. 73; Klein, Pisc. Miss. v, p. 32. *Diminutive Blenny*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 277.

Blennius galerita, Linn. Syst. i, p. 441; Bloch, Schn. p. 169; Montagu, Wern. Mem. i, p. 98, pl. v, f. 2; Turton, p. 92; Jenyns, Man. p. 381; Günther, Catal. iii, p. 222; Steind. Ich. Span. u. Port. 1868, p. 6; Cornish, Zoologist, 1878, p. 424; Giglioli, Pesc. Ital. p. 31; Vinciguerra, Blen. Genova, An. Mus. Civ. Genova, xv, 1880, p. 440, c. fig.

Blennius Montagui, Flem. Brit. Anim. p. 206; Cuv. and Val. xi, p. 234, pl. cccxxii; Yarrell, Brit. Fishes (Ed. 1) i, p. 219, c. fig. (Ed. 2) i, p. 249 (Ed. 3) ii, p. 355; Guichen. Expl. Algér. Poiss. p. 72; White, Catal. p. 46; Canestrini, Arch. Zool. ii, p. 99, t. iii, f. 4; Moreau, Poiss. France, ii, p. 138.

Blennius Artedii, Cuv. and Val. xi, p. 231; Guichen. l. c. p. 72; Lowe, Trans. Zool. Soc. iii, p. 9.

Blennius inæqualis, Lowe, Trans. Zool. Soc. ii, p. 185.

Ichthyocoris Montagui, Bonap. Pesc. Eur. 67, No. 623.

Adonis galerita, Gronov. ed. Gray, p. 95.

Montague's blenny, Couch, Fish. Brit. Isles, ii, p. 231, pl. cxiii, f. 3.

B. vi, D. $\frac{12-13}{15-17}$, P. 12, V. 2, A. 17-18, C. 11.

Length of head $4\frac{1}{3}$ to $5\frac{1}{2}$, of caudal fin $6\frac{1}{2}$, height of body 5 to $5\frac{1}{2}$ in the total length. *Eye*—high up, diameter $3\frac{1}{2}$ to 4 in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 2/3 of a diameter apart. Interorbital space nearly flat, snout short, and the anterior profile very abrupt. Passing from the summit of the edge of one orbit to the other is a fleshy, erectile, transverse fold of skin, sometimes 1/2 as long as the head, which is fringed with fine tentacles: while in a row along the nape running from it towards the dorsal fin is another row of fine tentacles. Anterior nostril with a short fringed tentacle. *Teeth*—a single row of very fine ones in either jaw, from 55 to 65 in the upper and 35 to 45 in the lower. Posteriorly in the lower jaw is a curved canine, whereas none exists in the upper. *Fins*—the dorsal commences on a vertical line behind the hind edge of the opercle, its spines are flexible and about 2/3 as high as the body, while it is deeply notched between its spinous and rayed portions, which latter is the higher, and posteriorly it is not continuous with the caudal, which is almost square at its extremity. Pectoral reaching

to above the commencement of the anal, its 6th to 8th rays the longest. Anal is not continuous with the caudal. *Colours*—of a light brownish or yellowish gray, with six to nine vertical bands, not so wide as the ground colour, descending from the back two-thirds down the body: the whole of the body and the head are studded with bluish-white spots, and a line of large milk-white blotches runs from opposite the lower edge of the pectoral to the lower third of the caudal fin. Pectoral with a black band at its base, some dark spots and two rows of white blotches. Fins yellowish: dorsal with irregular and oblique rows of black spots: anal, and sometimes the soft dorsal, with a black outer edge; caudal with three to five dark vertical bands, and two light blotches near its base. Tentacle on head red or orange.

Varieties.—Shows great variation in colour, being very much darker in some localities than it is in others.

Names.—There can be but little doubt that this is the species alluded to by Artedi as *Blennius crista capitis transversa, cutacea*, but he erroneously refers to Rondelet whose blenny termed *galerita*, or "crested lark," was the *B. pavo* of Risso. This fish is evidently the species alluded to by Solander, which he observed near Plymouth and thus recorded: "*Blennius comatus*, crista capitis interoculari, lanceolata, ciliata," &c.

Habits.—It prefers small rock pools in which sea-weed exist, or crevices, or under ledges of stone where it can retire into: here it remains sometimes dry for several hours during the day, crawling about, or if frightened jumping. It is very active, and may be seen peeping out of its crevices, but is rather solitary or seen only in pairs. I obtained many live ones from the rock pools at Penzance (August, 1881), and particularly noticed whether the crest on the head was erectile or not so. Out of the first ten, eight died with it erected, in the other two it was laid flat: I then took one without injury by means of a hand-net and transferred it to a vase of sea-water. At first its crest was flat, but after three or four hours it was constantly erect. Two shannies and one Montagu blenny were placed in a larger aquarium with a whistler (*Motella*); they at once flew at it, seized it by the throat, and killed it. It is difficult to retain in water, requiring a net cover, but I could not perceive that its activity was greatest in accordance with the tides (see page 204).

Means of capture.—These little creatures are captured in rock pools in a similar way to the shanny, and they are about equally active and able to secrete themselves.

Breeding.—August, on the under surface of a stone beneath which it shelters itself.

As food.—It is too insignificant to be of any use except to birds and larger fish.

Habitat.—In the Atlantic from the British Isles to the Canaries, also locally distributed throughout the Mediterranean and Adriatic to the Black Sea.

Banffshire (?) it has been recorded as having been obtained from the stomach of a haddock (Edward). At Weymouth an example was dredged in 1854 (P. Gosse, Zoologist); Devonshire (Montagu), near Plymouth (Solander), while it is very numerous at Penzance, in Cornwall. Mr. Cornish observes (Cornish Fauna, p. 40), that it is not uncommon in Mount's Bay.

It does not appear to often exceed 2 or 3 inches in length in the British Isles, but attains to rather a larger size in the Mediterranean.

3. **Blennius ocellaris,** Plate LIX, fig. 2.

Scorpioides, Rondel. vi, c. 20, p. 204; Gesner, p. 847; Aldrov. p. 116. *Blennius*, Salv. Aq. p. 217; Belon. p. 221; Gesner, p. 130; Aldrov. p. 203; Jonston, i, tit. 3, c. 1, Art. 15, t. xix, f. 5; Willugh. p. 131, t. H 3, f. 2; Ray, p. 72. *Blennius*, No. 1, Artedi, Gen. p. 26; Klein, Pisc. Miss. v, p. 31, No. 1.

Blennius ocellaris, Linn. Syst. Nat. i, p. 442; Brünn. Pisc. Mass. p. 25; Bl. t. clxvii, f. 1; Bl. Schn. p. 168; Shaw, Brit. Zool. iv, p. 165, pl. xxiv; Bonn. Atl.

Ich. p. 53, t. xxxi, f. 113; Risso, Ich. Nice, p. 125, and Eur. Mérid. iii. p. 229; Montagu, Wern. Mem. ii, p. 443, pl. xxii, fig. 2; Martens, Reise nach Venedig, ii, p. 418; Cuv. and Val. xi, p. 220; Yarrell, Brit. Fish. (Ed. 1) i, p. 223, c. fig. (Ed. 2), i, p. 253 (Ed. 3) ii, p. 359; Forbes, Mag. Nat. Hist. 1836, ix, p. 203; Flem. Brit. An. p. 206; Jenyns, Man. p. 378; Cuv. Règ. Anim. Illus. Poiss. pl. lxxvii, f. 1; Günther, Catal. iii, p. 222; Canestrini, Arch. Zool. Anat. Genova, 1862, ii, p. 87, t. ii, f. 2; Steind. Ich. Span. u. Port. 1868, p. 7; Vinciguerra, Blenn. Genova, Ann. Mus. Civ. Genova, xv, 1880, p. 439; Giglioli, Pesc. Ital. p. 31; Moreau, Poiss. France, ii, p. 128.

Blennius papilio (Gmel. Linn.) Guichen. Explor. Algér. Poiss. p. 70.

Blennius lepus, Lacép. ii, p. 461.

Blennius ocellatus, Swainson, Fishes, ii, p. 273.

Adonis pavoninus, Gronov. ed. Gray, p. 93.

Butterfly blenny, Couch, Fish. Brit. Isles, ii, p. 224, pl. cxii.

B. vi, D. $\frac{11-12}{14-16}$, P. 12, V. 2, A. 16-18, C. 11, Vert. 11/21-22.

Length of head 4 to $4\frac{1}{2}$, of caudal fin 6, height of body $4\frac{1}{4}$ to $4\frac{2}{3}$ in the total length. *Eye*—near dorsal profile, diameter 4 to $4\frac{1}{2}$ in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 3/4 of a diameter apart. Interorbital space rather concave from side to side, snout short with the anterior profile very abrupt. A fleshy tentacle, sometimes as long as the eye, and which is fringed along its posterior surface, is situated on the anterior portion of the superciliary ridge: also a short fringed tentacle at the anterior nostril. *Teeth*—a single row in either jaw, consisting of about 36 to 40 in the upper, and 34 or 36 in the lower. Posteriorly a strong curved canine in either jaw. *Fins*—the dorsal commences on the nape, the first spine is high in adults, usually equalling or exceeding that of the body below it, from whence it decreases to the last, which equals about 2 diameters of the orbit in height: in adults the termination of the spine projects some distance beyond the interspinous membrane: rayed portion of the dorsal as high as the body below it, but not equalling that of the spinous part of the fin, it is not continuous with the caudal, which latter is rounded, square, or even slightly emarginate in the young. Seventh to ninth pectoral rays the longest. Anal similar to the second dorsal. *Colours*—gray, with six or seven vertical bands on the body, narrower than the ground colour, and which become lighter in the adult. Many irregular reticulations of gray lines over the lower half of the head and the body, on which latter are many dark spots. Dorsal fins of a light gray, with some darker reticulations: a large round black ocellus surrounded by a narrow white ring exists on the first dorsal fin, between the fifth and ninth dorsal spines: soft dorsal with some narrow irregularly oblique dark bands. Pectoral with fine black dots on the upper rays, the lower ones being black externally with a narrow white edging. Anal dark in its outer half. Caudal gray, with some rows of black spots.

Varieties.—The black mark on the first dorsal fin appears to be occasionally absent.

Names.—*Butterfly-blenny*, from its appearance. *La blennie papillon*, French.

Habits.—In the Mediterranean Risso observed that it lived among Algæ, feeding upon minute crustaceans, molluscs, and even small fish and sea-weed. It appears to be sometimes taken at considerable depths.

Breeding.—In the spring in the Mediterranean (Risso).

As food.—Its flesh is soft, glutinous, and of little taste.

Habitat.—Occasionally taken along the south-west coast of England, but has been recorded as having been dredged up on a scollop bank in twenty fathoms of water, off Ballough, in the Isle of Man, in June, 1834 (Forbes, Mag. Nat. Hist. 1836, ix, p. 203).

"This pretty fish was formerly, and until the severe winter some three or four years since, tolerably plentiful in this bay: since then it has totally disappeared. I have the last week, however, obtained two specimens" (W. Thompson, Weymouth, Feb. 22nd, 1857, Zool. p. 5608). Portland (Yarrell). It was first obtained at

Torcross, in Devonshire, by Montagu, who dredged three examples. It is not uncommon at Falmouth (Cocks): it has been captured at Dawlish (D'Urban). In Dorsetshire it has been found to be frequent in the autumn.

A single specimen taken by a trawl in 1845, Mount's Bay, "but the spot on the first dorsal fin was so obscure as scarcely to be noticed" (R. Couch). It is not rare in the Channel Islands and extends through the Mediterranean. I have to thank Mr. Carrington, F.L.S., for two examples from Guernsey, captured in 1880, the largest being $4\frac{1}{4}$ inches in length.

This fish attains to at least 7 inches in length.

4. Blennius pholis, Plate LX, fig. 2.

Pholis, Aldrovandus, i, c. 25, p. 116; Gesner, p. 714; Jonston, i, tit. 2, cap. 2, Art. 1, t. xvii, f. 4; Willughby, p. 135, t. H 6, f. 4; Ray, pp. 73 and 74; Artedi, Synon. p. 116. *Blennius*, sp. Gronov. Zooph. No. 259 and Mus. Ichth. ii, p. 22, No. 175. *Cataphractus lævis*, Jago in Ray's Pisc. p. 164, f. 10. *Smooth blenny*, Pennant, Brit. Zool. (Ed. 1) iii, p. 208, pl. xxxvi (Ed. 2) iii, p. 280, pl. xl.

Blennius pholis, Linn. Syst. i, p. 443; Bloch, Fis. Deut. ii, p. 184, t. lxxi, f. 2; Bl. Schn. p. 170; Shaw, Brit. Zool. iv, p. 177, pl. xxiv; Bonn. Atl. Ich. p. 54, t. xxxii, f. 118; Lacép. ii, p. 489; Donovan, Brit. Fish. iv, pl. lxxix; Turton, p. 93; Jenyns, Man. p. 382; Parnell, Fish. Firth of Forth, p. 73, and Wern. Mem. vii, p. 233; Yarrell, Brit. Fish. (Ed. 1) i, p. 230, c. fig. (Ed. 2) i, p. 260 (Ed. 3) ii, p. 366; Couch, Trans. Linn. Soc. xiv, pp. 74, 75; Martens, Reise nach Venedig, ii, p. 419; Thompson, Pro. Zool. Soc. 1835, p. 80, and Nat. Hist. Ireland, iv, p. 110; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Johnston, Berwick. Nat. Hist. Club, 1838, i, p. 171; Günther, Catal. iii, p. 226; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Edin. v, 1862-1866, p. 614, and Fish. St. Andrew's, p. 175, pl. vi, f. 4; Steind. Ich. Span. u. Port. 1868, p. 8; Collett, Norges Fiske, p. 72; Giglioli, Pesc. Ital. p. 31; Vinciguerra, Itto. Col. Mus. Civ. Genova, p. 451, c. fig.; Moreau, Poiss. France, ii, p. 143.

Pholis lævis, Flem. Brit. Anim. p. 207; Cuv. and Val. xi, p. 269; Cuv. Règne Anim. Illus. Poiss. pl. lxxvii, f. 2; Nilss. Skan. Faun. Fiske, p. 182.

Adonis pholis, Gronov. ed. Gray, p. 96.

Shanny, Couch, Fish. Brit. Isles, ii, p. 226, pl. cxiii, f. 2.

B. vi, D. $\frac{11-13}{18-20}$, P. 13, V. 2, A. 18-20, C. 13.

Length of head $4\frac{1}{2}$ to $4\frac{2}{3}$, of caudal fin 6 to 7, height of body $4\frac{1}{4}$ to 5 in the total length. *Eye*—diameter $4\frac{1}{2}$ to 5 in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout. Interorbital space nearly flat. No orbital tentacle. Anterior nostril with a short tentacle divided at its extremity into four or five filaments. *Teeth*—a curved tooth exists at the angle of moderate size in both jaws, that in the mandible being a little the largest, the number of teeth slightly vary with age, thus in examples under 3 inches I found 14 in the upper and 12 in the lower jaw, at $3\frac{1}{2}$ inches from 16 to 18 in the upper and 13 to 14 in the lower jaw: from 4 to $4\frac{1}{2}$ inches, 19 to 20 in the upper and 16 in the lower jaw. *Fins*—the dorsal commences slightly before the vertical from the hind edge of the opercle: its spines are flexible: it is notched between its two portions, while posteriorly it is not continuous with the caudal. *Scales*—absent. *Colours*—greenish-olive or yellowish: banded, blotched, or spotted with black. Fins yellowish, also black spotted, while the anal has a black, white-margined, outer edge. Their colours are very various and while in the water are least marked. In most examples from the coasts of Cornwall and Devonshire I observed during life a large blue spot on the cheek, behind and below the eye, and a light band along the lower part of the side, much as seen in *B. galerita*.

Varieties.—Mr. Dunn has obtained two scarlet examples from crab-pots. Mr. Greatwood (Zool. p. 2029) observed respecting the changes of colour in this fish, that it is of a pale yellowish-brown while in water, but after inhaling atmospheric air freely for some time, its hue changes to a deeper brown, and a series of white spots on the lateral line become conspicuous.

Names.—*Shanny* or *shan*: said to have been formerly known in Cornwall as

Mullgrannoc and *Bulcard*, now as *Bully* or *Bully cod*, Cornish. *Stone-fish*, Parnell. *Shaw* and *parrot-fish*, Ireland. *Le Pholis*, French.

Habits.—This fish is found in rock pools accessible at low water, and does not appear to frequent deeper localities. It frequents most of our rocky coasts and is exceedingly active, creeping with great facility up and between stones and crevices in rocks, where it may be frequently seen looking out but immediately withdraws its head should it fancy itself perceived. It appears to voluntarily spend a considerable portion of its time out of the water, remaining on rocks or within crevices where by aid of its pectoral and ventral fins, aided by its tail, it can creep either forwards or backwards and spring actively about. If frightened it will readily conceal itself under stones or among sea-weed, and should it be captured it will seize the captor's finger, to which it will hold on with considerable tenacity.

One was captured at Topsham, in Devonshire, in June, 1847, and having been placed in a salt water aquarium was quiet for some hours, but subsequently tried continuously to jump out. Having placed an *Actinia* in the glass the blenny immediately leaped on to it completely out of the water, it was then low tide. The tide flowed till ten o'clock, and exactly at that time it plunged again into its natural element, and during five months Mr. Ross asserted that it proved a regular and correct tide indicator. It had the power of altering its position with great facility by means of its pectoral and ventral fins. At times it reclined on its side: or it remained quite erect resting on its pectorals, rotating its head.

It is tenacious of life, living for some time after its removal from its native element. Donovan having remarked on its having continued alive for thirty hours under such circumstances, and Montagu that if kept in damp situations it may live days, Couch observed that it soon expires if placed in fresh water. Lacépède records how one of these fishes was found enclosed within the two valves of an oyster shell, where it is supposed it had entered in order to feed on the oyster. After it had been dredged and carried to a considerable distance, the fish was found alive in its prison. At Looe, in Cornwall, Mr. Clogg obtained a mussel which had closed its two valves on a shanny, opposite the middle of its pectoral fin. It had been taken by a fisherman in search of bait: the fish when first brought into the boat was alive, with its head firmly fixed by the mussel in its deadly grasp.

It eats insects, shells, small crustacea, and sea-weed. McIntosh, at St. Andrew's, observed that it feeds on *Balani*, small littoral shells, and sessile-eyed crustaceans.

In one I examined at Penzance I found among other things several shells of the common mussel, three of which had passed the pylorus.

An example was retained in confinement more than half a year at Ventnor, kept in a tumbler of sea water of about three quarters of an inch in depth. Anything that moved it ate: if an insect was placed outside the tumbler it made vigorous struggles to penetrate the glass to get at it. Mr. Guyon (Zool. p. 3514) observes this fish devoured spiders, scolopendræ, caterpillars, and mulluscs, every movable creature being acceptable to it, nor did it disdain a bit of roast beef, mutton, fowl, or chop. One kept by Couch for upwards of six months in confinement did not increase in size. In warm weather it mounted on to a stone in the tank, where it basked for hours at a time, so that in summer full half of its time was spent out of the water: but when the air grew colder it remained under water. In no case did its actions correspond with the ebb and flow of the tide as described above.

Breeding.—It deposits its ova on the upper surface of small caverns in the rocks (R. Couch, Zool. 1846, p. 1419), about June, according to Parnell, while Mr. Dunn considers some at least spawn in spring. I took minute ones at Penzance in August.

Uses.—May be employed as a bait for crab and lobster-pots.

As food.—Too small to be of any consequence.

Habitat.—From Scandinavia and the Atlantic coasts of Europe, but it does not appear to extend far, if at all, into the Mediterranean, where *Blennius Canevæ*, Vinciguerra (Ann. Mus. Civ. xv, 1880, p. 448), would seem to represent it. This

latter form has the tentacle at its anterior nostril simply bifid at its extremity: about 30 teeth in the upper and 26 to 28 in the lower jaw. Its fin rays are D. 13/15, A. 2/15-16.

The shanny appears to be distributed almost everywhere in pools between tide marks around the British coast, and has been recorded from Banffshire (Edward): Aberdeen (Sim), here I procured an example, and several likewise from St. Andrew's: Moray Firth: common in the Firth of Forth (Parnell): Berwickshire (Johnston): Yorkshire, resident and common in rock pools from Redcar to Flamborough (Fauna of Yorkshire, p. 113): Norfolk, among stones at low tide (Gurney), abundant at Weymouth (Gosse), and very common all along the south coast, especially in Devonshire and Cornwall. Pennant found it to be common in Anglesea, but Donovan observed that in the thirty years which had elapsed since Pennant's remarks were published he found it had disappeared (except in one spot), and this he attributed to the tang having been almost eradicated for the use of glass-makers, &c.: also Pembrokeshire.

In Ireland it is common around the coast (Thompson).

It attains to at least 6 inches in length.

Genus III.—Carelophus, *Kröyer.*

Gunnellus, Cuv. and Val.; *Chirolophis*, Swainson; *Blenniops*, Nilsson.

Branchiostegals six: pseudobranchiæ present. Body elongated and compressed. Gill openings of moderate width, and the membranes of the two sides connected with each other. Small teeth in the jaws, none on the palate. Dorsal fin long and entirely formed of spines: ventrals present and jugular: caudal distinct. Scales small, covering the body. Lateral-line not developed. Air-bladder and pyloric appendages absent.

Swainson (1839) considered the fish which forms the sole example of this genus to be a sub-generic type, representing the Gunnell Blennies, but stated that its precise situation required much investigation.

Geographical distribution.—From the coasts of Scandinavia to those of the British Isles.

1. Carelophus Ascanii, Plate LX, fig. 3.

Blennius toupée, Ascan. Ic. t. xix. *Crested Blenny*, Pennant, Brit. Zool. (Ed. 1) iii, p. 206, pl. xxxv (Ed. 2) iii, p. 276, pl. xxxix.

Blennius galerita, Linn. Syst. Nat. p. 441 (in part); Flem. Brit. Anim. p. 207; Bonn. Atl. Ich. p. 52, pl. xxxii, f. 116; Nilss. Prod. Ich. Scand. p. 102; Turton, Brit. Fauna, p. 92.

Blennius Ascanii, Walbaum, Art. Renov. iii, p. 173; Rein. Maanedsk, f. Liter. 1833, p. 259; Kröyer, Nat. Tids. i, 1837, p. 372; Günther, Catal. iii, p. 284, and Ann. and Mag. 1874 (4), p. 139; McIntosh, Fish. St. Andrew's, p. 175; Ogilby, Zoologist, 1876, p. 4753.

Centronotus Brosme, Bl. Schn. p. 167.

Blennius coquillad, Lacép. iii, p. 477.

Blennius Pennantii, Jenyns, Brit. Vert. p. 24; White, Catal. Brit. Fish. p. 47.

Blennius palmicornis, Yarrell, Brit. Fish. (Ed. 1), p. 233, c. fig.; Jenyns, Manual, p. 380 (not Cuv.).

Blennius Yarrellii, Cuv. and Val. xi, p. 218; Yarrell, l. c. (Ed. 2) i, p. 263 (Ed. 3) ii, p. 371; Bonap. Pesc. Eur. 67; Johnston, Berwick. Nat. Club, 1838, i, p. 171; Thompson, Nat. Hist. Ireland, iv, p. 109.

Gunnellus Stroemii, Cuv. and Val. xi, p. 444.

Chirolophis Yarrellii, Swainson, Fishes, ii. p. 275.

Blenniops galerita, Nilss. Skan. Faun. Fisk. p. 185.

Carelophus Strömii, Kröyer, Dan. Fis. i, p. 602.

Carelophus Ascanii, Collett, Norges Fiske, 1875, p. 76.

Yarrell's blenny, Couch, Fish. Brit. Isles, ii, p. 233, pl. cxiv.

B. vi, D. 50-52, P. 14, V. 1/3, A. 36-40, C. 17.

Length of head $5\frac{1}{2}$ to 6, of caudal fin $8\frac{1}{2}$ to $9\frac{1}{3}$, height of body 6 to $7\frac{1}{2}$ in the total length. *Eye*—diameter 4 to $4\frac{1}{2}$ in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 1 apart. A well-developed, erectile, supraorbital tentacle, which posteriorly and superiorly is edged with fine filaments. In front of this are two smaller ones at the nostrils, said occasionally to be absent; while behind these are several simple filaments. Snout short. Cleft of mouth rather oblique, the hind edge of the maxilla reaching to beneath the front edge of the eye. *Teeth*—a single row of closely-set small ones. *Fins*—dorsal consisting of spines, about half the height of the body, extends from above the hind end of the head as far as the base of the caudal fin: the first three having some filaments at their extremities which are much longer in some examples than they are in others. Pectoral with its rays branched, it reaches to above the commencement of the

anal. Ventrals short. Caudal distinct. *Scales*—small, present over the body. *Colours*—reddish brown, becoming lighter beneath: a series of about eleven bands of slightly darker hue, but narrower than the ground colour, descend from the back to the abdominal surface. Dorsal and anal fins light coloured with a central darker band along their entire extent. In some the fish is entirely of a simple reddish brown, mottled all over.

Habits.—Appears along the south-west coast to frequent deep water at rarely less than from five to eight fathoms, but in the north is recorded as having been found within tide marks. Mr. Peach observed of an example which he kept alive in an aquarium, that it generally rested with its tail turned towards its head, the posterior portion of the anal fin being laid flat outside, or almost at right angles to the body, as if to support the curved part of the tail. Besides possessing the power to turn the tail to either side, it appeared also to be able to elevate or depress it. A young one, now in the British Museum collection, was taken in the voyage of the "Porcupine" in the sea at 180 fathoms' depth between Shetland and Faro.

Means of capture.—Has not been recorded to have taken a bait: but is occasionally found in crab-pots.

Habitat.—From the coasts of Scandinavia and Denmark to around the British Isles. Orkneys and Shetland Isles, being frequent at times especially in Kirkwall Bay (W. Baikie). It has been recorded from Wick, in Scotland (Peach); Loch Broom, Ross-shire (Fleming); one from the Moray Firth in 1839; another in 1853 also at Peterhead (Harris); Banff, but rarely met with (Edward); Aberdeen (Sim); Berwick (Johnston); Redcar, Sept. 1835 (Teale) in Yorkshire, where, though resident it is extremely rare (Fauna of Yorkshire, p. 113); one in July, 1854, at Weymouth (T. Gosse); also Thompson records one taken at Portland, Feb. 27th, 1850, and one in Chesil Bay on April 7th the same year. Although not uncommon in Cornwall, it is rare in west Cornwall, an example captured at Penzance in 1878 being the first recorded (Cornish). A single example has been taken at Land's End, "but it has been so frequent in other parts of south Cornwall, that its rarity has arisen from the limited search I have been able to make for it" (R. Couch).

Ireland.—Two examples captured at Carrickfergus in May, 1839; in 1868 one at Dingle Harbour, Kerry; also seen on the coast and island of Connemara (More, Zool. 1878, p. 297); and two in crab-pots at Portrush, co. Antrim, 1875 (Ogilby, Zool. p. 4753). Yarrell alludes to it in the counties of Wicklow and Down, and Thompson to its presence in Dalkey Sound.

The example figured is 7 inches in length, and in the national collection. This fish attains to at least $7\frac{1}{2}$ inches in length.

Genus IV.—**Centronotus**, *Bloch, Schneider.*

Gunnellus, Fleming; *Ophisomus*, Swainson.

Branchiostegals five: pseudobranchiæ present. Body elongated and compressed. Gill-openings of moderate width, and the membranes of the two sides connected with each other. A row of small, conical teeth in the jaws, and occasionally on the palate. Dorsal fin long and entirely formed of spines. Ventrals, if present, irregular and rudimentary: caudal distinct. Scales very small, covering the body. Lateral-line not developed. Air-bladder and pyloric appendages absent.

Fleming united *Centronotus* and *Zoarces* with the genus *Gunnellus*.

Hughes, Zool. 1874, p. 3896, observes of *Centronotus gunnellus*, that although allied to the blennies, it has none of the tameness and familiarity which characterizes the latter genus, neither is it so fond of raising itself on a rock above water mark as they are. He also thought that it might be nocturnal in its habits, for during the day it remains partially coiled up round a weed or stone, but in the evening glides about with a graceful snake-like motion taking its food, which it strikes at as a viper wounds its enemy.

Geographical distribution.—From the northern seas to the coasts of Great Britain and France in Europe; in America extending at least as far south as New York. It has also been found in Decastris Bay and the mouth of the Amoor in the North Pacific to Japan and California.

1. **Centronotus gunnellus**, Plate LXI, fig. 1.

Gunnellus cornubiensis, or *Butter-fish*, Willugh. p. 115, c. 9, t. G 8, fig. 3; Ray, p. 144; Petiver, Gazoph. t. li, f. 4; Seba, iii, p. 91, t. xxx, f. 6. *Blennius*, sp. Artedi, Genera, p. 27, No. 5. *Tang-Brosme*, 3, Ström. i, p. 315 and Norsk. Vid. Selsk. Skr. Nya Saml. i, p. 148. *Pholis*, sp. Gronov. Zooph. No. 267, and Mus. Ich. i, No. 77, p. 33. *Spotted blenny*, Pennant, Brit. Zool. (Ed. 1) iii, p. 210, pl. xxxv (Ed. 2) iii, p. 282, pl. xxxix; Low, Nat. Hist. Orkney, p. 202. *Purple blenny*, Lowe, l. c. p. 203; Parn. Wern. Mem. vii, p. 235 (variety ?).

Blennius gunnellus, Linn. Faun. Suec. p. 114, No. 318, and Syst. Nat. p. 1181; Bonn. Ency. Ich. p. 55, pl. xxxii, f. 119; Bl. Fische Deut. ii, p. 186, t. lxxi, f. 1; Lacép. ii, p. 503; Donovan, Brit. Fishes, ii, p. 27; Shaw, Brit. Zool. v, p. 179, pl. xxiv; Turton, Brit. Fauna, p. 93; Jenyns, Manual, p. 383; Müll. Prod. Zool. Dan. p. 43; Faber, Fische Isl. p. 76; Pall. Zoogr. iii, p. 173; Richards. Faun. Bor.-Amer. Fishes, p. 91; Retz. Faun. Suec. p. 324 (not Fabr.); Johnston, Berwick. Nat. Club, 1838, i, p. 171.

Gunnellus Europeus, Olafs, Reise, i, p. 81, and Beskr. over Skagen, p. 165, t. iii, f. 1.

Blennius maculis X, Olafs, Reise, § 680, t. x, f. 12, 13.

Blennius murœnoides, Sujef, Act. Petrop. 1779, ii, p. 195, t. vi, f. 1; Gmel. Linn. p. 1184 (*young*).

Centronotus gunnellus, Bl. Schn. p. 167; Fries och Ekstr. Skand. Fisk. p. 105, t. xxv. f. 1; White, Catal. p. 48; Günther, Catal. iii, p. 285; Gill, Proc. Ac. Nat. Sc. Phil. 1864, p. 200; McIntosh, Fish. St. Andrew's, p. 176; Winther, Ich. Dan. Mar. 1879, p. 23.

Gunnellus vulgaris, Flem. Brit. Anim. p. 207; Cuv. and Val. xi, p. 419; Bonap. Pesc. Eur. 69; Nilss. Skand. Fauna, Fisk. p. 200; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Schlegel, Dieren Neder. p. 6; Moreau, Poiss. France, ii, p. 153.

Murœnoides guttata, Yarrell, Brit. Fish. (Ed. 1) i, p. 239, c. fig. (Ed. 2) i, p. 269 (Ed. 3) ii, p. 376; Parnell, Fishes Firth of Forth, p. 75 and Wern. Mem. vii, p. 235; Thompson, Nat. Hist. Ireland, iv, p. 110.

Ophisomus gunnellus, Swains. Fish. ii, p. 277.
Pholis gunnellus, Gronov. ed. Gray, p. 99.
Gunnellus ingens, Storer, Boston Journ. Nat. Hist. 1850, vi, p. 261, pl. viii, f. 1.
Butter-fish, Couch, Fish. Brit. Isles, ii, p, 236, pl. cxv.

B. vi, D. 75-82, P. 11-12, V. 1/1-2, A. $\frac{2}{39-45}$, C. 15, Vert. 84-86.

Length of head $7\frac{1}{2}$ to $8\frac{1}{4}$, of caudal fin $13\frac{1}{2}$, height of body $7\frac{1}{2}$ to $9\frac{1}{2}$ in the total length. *Eye*—near the upper profile, diameter 5 in the length of the head, 1 diameter from the end of the snout, and 3/4 of a diameter apart. Snout short. Cleft of mouth oblique, commencing superiorly opposite to the upper edge of the eye: the posterior extremity of the maxilla reaches to beneath the front edge of the orbit. Nostrils simple. *Teeth*—in the jaws in a single row of conical ones placed a slight distance apart. None on the palate or tongue. *Fins*—the dorsal, which is low, consists of moderately strong spines with an interspinous membrane, it commences above the hind edge of the opercle, and is continued to the base of the caudal where it is connected to the latter fin by a low membrane. Pectoral inserted a little behind the head and in the lower half of the depth of the body. Ventral situated beneath the base of the pectoral: its spine rather strong. Anal low, it commence sbeneath the middle of the dorsal, and consists of two short spines and the rest branched rays. It is connected with the caudal similarly to the dorsal: caudal rounded. *Scales*—minute, covering the body, but none on the head. Skin very slimy, due to the large amount of mucous which is secreted. *Colours*—when first captured yellow, becoming gray shortly after death. A single row of from nine to thirteen round black ocelli, encircled with a white ring, are present on the upper surface of the back, extending on to the base of the dorsal fin, or they may be restricted to either of those situations. A dark brown band descends from the eye to behind the angle of the mouth. The body is irregularly banded, the bands descending from the back to the abdomen. As age advances they become more broken up and appear as reticulations. These bands are continued upwards on to the dorsal fin and descend on to the anal. The caudal yellow, with or without two vertical bands.

Varieties.—Those of colour are not uncommon, but the black spots are usually as numerous in the young as they are in the adults. Lowe mentions one which only had one spot at the beginning of the back fin, but not otherwise differing from the normal form.

Gill, in the Proceedings of the Acad. Nat. Sc. Phil. 1864, p. 200, has, in an exhaustive paper, given reasons for considering *Ophidium imberbe*, Linn. Montagu, Wern. Mem. i, p. 95, pl. iv, f. 2; Turton, p. 88; Fleming, p. 201; Jenyns, p. 481; Yarrell (Ed. 1) ii, p. 314 (Ed. 2) ii, p. 412. *Cepolophis Montagui*, Kaup, Wieg. Arch. 1856, p. 97. *Gymnelis imberbis*, Kaup, Apod. p. 156; Yarrell (Ed. 3) i, p. 79; Günther, Catal. iv, p. 325; and *Ophidium eel*, Couch, iv, p. 333, to be the young of this species. The number of rays in the two are similar, &c. Whereas Pennant's *Beardless ophidium* seems to be very closely allied to, if not similar with, the common eel.

Names.—Owing to its body being compressed, it is termed the *Swordick* or *Sword-fish* in Orkney. *Stane-checker*, Scotland. *Butter-fish*, from its soft and unctuous feel; and *Nine-eyes*, Cornwall, from its markings. Traditionally said to have derived its designation *gunnel*, owing to Ray's having shown one to a fisherman, and inquiring its name was answered that "it looked very much like a gunnel"—meaning the gunwale of a small boat; he however supposing this to be the local term, recorded it. *Gonnelle vulgaire*, or locally at Poitou *Papillon de mer*, French.

Habits.—This marine fish is found chiefly between tide marks, especially in oozy ground, sheltering either singly or in larger numbers under sea-weed (*Fuci*) hanging over rocks, and especially if the ground be gravelly or shingly; it may also be taken under stones left dry by a receding tide. It wriggles rapidly away, while, due to its slimy nature, it is difficult to hold, and in the water swims with considerable speed. It lives some time (even two or three days) after removal from the sea, being very tenacious of life. At St. Andrew's, McIntosh found that its food "includes *Hippolyte*, sessile-eyed

crustacea, annelids, star-fishes, and small mollusca (*Rissoa*, *Skenea*, &c.)." It consumes marine insects, and is said to be very destructive to the fry and eggs of other fishes. Mr. Dunn observes MSS.: "I have a *butter-fish*, Couch, caught near the surface of the sea in a pilchard net, three miles from land, in 35 fathoms of water" (Dec. 28th, 1880).

Means of capture.—Generally by dredges, or hunting among the localities it frequents when the tide is out.

Breeding.—Nilsson states its spawn to be deposited in November. Mr. Peach, however, in June believed he discovered the spawn of this fish at Fowey, in Cornwall.

Uses.—It forms a good bait for pollock, cod, mackerel, gurnards, &c., in some places being used alive for this purpose, in others split up, the skin and vertebral column being removed.

As food.—Its flesh is said to be hard and indifferent. But the Greenlanders have been reputed to dry and salt them for their winter provisions.

Habitat.—Coasts of Iceland, Greenland, Norway, and Finland, to the British Isles and France. In the Orkneys it is frequently found under stones at low water-mark, or above it among the sea-ware (Lowe); also in Zetland (Baikie). In the Moray Firth it is very common in pools below high water-mark (Gordon, Zool. 1852, p. 3460); at Banff among low lying rocks (Edward); Aberdeen (Sim); very common also in the Firth of Forth (Parnell); Berwickshire (Johnston). In Norfolk, it has been mentioned as existing at Yarmouth (Paget) and Cromer (Gurney), and not uncommon in Yorkshire (Fauna of Yorkshire). Plentiful in the Lincolnshire flats (Yarrell), also in the Norfolk estuary (Lowe). Along the south coast, being very numerous off Dorsetshire, Devonshire, and Cornwall. It has likewise been reported from Anglesea (Pennant). In Ireland very common around the coast at all seasons (Thompson).

The one figured, life size, I captured from under a stone at Dawlish, in Devonshire. It attains to at least 11 inches in length.

Genus V.—ZOARCES, *Cuvier.*

Mustela, Artedi (preoccupied among quadrupeds). *Zoarchus*, Swainson.

Branchiostegals six: pseudobranchiæ present. Body elongated and compressed. Gill-openings wide. Several rows of conical teeth in front of the jaws, a single row laterally, none on the palate. Dorsal fin long and formed of rays, except in a short, depressed and spinous portion near the end of the tail, these being the sole spines which exist. No fin extending round the end of the tail: ventrals jugular, formed of three or four rays. Scales rudimentary. Air-bladder absent: pyloric appendages, if present, rudimentary.

Swainson constituted this genus and *Anarrhichas* into family *Zoarchidæ.*

Geographical distribution.—From the northern seas to Scandinavia, Great Britain and France. The Atlantic coasts of North America; also Decastris Bay, Kamschatka.

2. Zoarces viviparus, Plate LXI, fig. 2.

Mustela vivipara et marina, Schonev. pp. 49, 50, t. iv, f. 2; Jonston, t. xlvi, f. 8; Willughby, p. 122, t. H 3, f. 5; Ray, p. 69. *Lumpen*, Willugh. p. 120, t. H, 1. *Guffer Ealpout*, Sibbald, Scot. Illus. iii, p. 25, pl. xix, f. 3. *Blennius*, sp. 7, Artedi, Synom. p. 45. *Enchelyopus*, sp. Klein, Miss. iv, p. 57, No. 12, t. xv, f. 1; Gronov. Zooph. no. 265, and Mus. Ich. i, p. 65. *Viviparous Blenny*, Pennant, Brit. Zool. (Ed. 1) iii, p. 211, pl. xxxvii (Ed. 2) iii, p. 283, pl. xli; Lowe, Fauna Orcadensis, p. 204.

Blennius viviparus, Linn. Syst. Nat. i, p. 443, and Mus. Ad. Fried. p. 69, pl. xxxii, Kon. Veten. Ak. Handl. 1748, p. 37, t. ii, and Faun. Suec. p. 113; Bonn. Atl. Ich. p. 55, pl. xxxii, f. 120; Shaw, Zool. iv, p. 180, pl. xxiv; Bl. iii, 2, p. 262, t. lxxii; Bl. Schn. p. 170; Müll. Zool. Dan, ii, p. 23, pl. lxvii; Walb. Artedi, Ren. iii, p. 185; Retz. Faun. Suec. p. 325; Siemsen, Fisch. Mecklenb. p. 26; Donov. Brit. Fish. ii, pl. xxxiv; Turton, Brit. Faun. p. 93.

Blennius viviparus, Lacép. ii, p. 496.

Gunnellus viviparus, Flem. Brit. Anim. p. 207.

Zoarces viviparus, Cuv. Règne Anim.; Jenyns, Manual, p. 384; Yarrell, Brit. Fish. (Ed. 1) i, p. 243, c. fig. (Ed. 2) i, p. 273; Nilss. Prod. p. 105; Cuv. and Val. xi, p. 454; Parnell, Fishes Firth of Forth, p. 73, and Wern. Mem. vii, p. 237; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Johnston, Berwick. Nat. Hist. Club, 1838, i, p. 171; Kröyer, Dan. Fis. i, p. 355, c. fig.; Thompson, N. H. Ireland, iv, p. 111; White, Catal. p. 49; Günther, Catal. iii, p. 295; Kner, Denks. Ak. Wiss. Wien, xxiv, 1865; McIntosh, Fish. St. Andrew's, p. 176; Schlegel, Dieren Neder. p. 65, pl. vi, f. 4; Steind. Ich. Span. u. Port. 1868, p. 10; Collett, Norges Fiske, p. 78; Winther, Ich. Dan. Mar. 1879, p. 23.

Zoarcœus viviparus, Ekstr. Fis. Mörkö, ed. Creplin, p. 241; Fries och Ekstr. Skand. Fisk. p. 36, t. viii, f. 1; Nilss. Skand. Faun. Fisk, p. 203; Yarrell, Brit. Fishes (Ed. 3) ii, p. 380, c. fig.

Zoarchus viviparus, Swainson, Fishes, ii, p. 283.

Enchelyopus viviparus, Gronov. ed. Gray, p. 100.

Viviparous Blenny, Couch, Fish. Brit. Isles, ii, p. 239, p. 116.

B. vi, 76-80/10/20-25, P. 19, V. 3, A. 84-89, Cœc. pyl. 2, Vert. 25/85.

Length of head $5\frac{1}{4}$ to 6, height of body 7 to 9 in the total length. *Eye*—5 to $5\frac{1}{2}$ diameters in the length of the head: 1 to $1\frac{1}{4}$ from the end of the snout, and about 1 apart. Lips thick, the posterior extremity of the maxilla reaches to beneath the middle of the eye. A row of large glandular orifices along the lower edge of the preopercle. *Teeth*—in several rows of conical ones in both jaws, becoming a single row laterally: none on palate or tongue. *Fins*—dorsal low, it commences just behind the occiput, is continued along the back, and near

its extremity suddenly becomes lower where there are ten spines, it is then completed by rays. The tail may be said to be destitute of a fin, those of the dorsal and anal conjoining. In young examples, as up to 3 or 4 inches in length, there are 13 or 14 distinct caudal rays, which atrophy with age. Anal commences at the third-fifth of the total length. Pectoral nearly as long as the head. Ventrals small. *Intestines*—the commencement of the small intestines has almost the same calibre as the stomach and two short appendages.* *Scales*—rudimentary, none on the head. *Colours*—olive, with irregular spots and bands on the head and body. In some the darker markings are arched in shape and continued on to the dorsal fin. Two or three arched bands exist on the pectoral.

Names.—*Eel-pout* was employed by Sibbald as referring to this fish in Scotland, and Paget states it also employed for it at Yarmouth (see *Lota vulgaris*). *Guffer-eel: Guffer* and *Green-bone*, Scotland. *Bards* (Edinburgh). *Muræna eels*, Berwick. *Burbot-eel*, Yorkshire (Clarke). *Puit-aal*, Holland. *Zoarces vivipare*, or locally at Abbeville, *Loquette*, French.

Habits.—Of these but little is known: it frequents sea-weed and conceals itself under stones similarly to other Blennoid forms. "Adult specimens are found near the beach at Lowestoft, and in the later summer months young ones, about an inch in length, are abundant in the upper part of the inner harbour of Lowestoft, where they frequent the mud banks and I think burrow into them" (Gurney in Norfolk Faun. p. 14).

Means of capture.—Found under stones, tang, &c., at low water-mark. In the Firth of Forth Parnell observes they are taken with lines during the winter months.

Breeding.—This fish is viviparous, bringing forth numerous young at a time, according to Willughby, in the depth of winter, or, as stated by Nilsson, throughout the year. Before midsummer it quits the bays and shores, retiring to the deep water. In February, 1807, Dr. Neill saw a female, 15 inches long, from which several dozens of young escaped alive. Parnell had an example, 6 inches long, sent him from which he removed fifty-six young all alive, although the parent fish had been dead for nearly two days. Each was an inch and a quarter in length, and on being put into a glass of fresh water they at first appeared remarkably active, but in less than half-an-hour afterwards they all expired. Inside the ovisac the young fish are separated by a thick and tenacious fluid, which has become absorbed by the time they are ready for extrusion. Willughby and others have estimated the number of young produced at one time from 200 to 300. Nilsson in a fish, 12 inches in length, found 195, and in another an inch longer, 262. As soon as they are born, when they would appear to be often $1\frac{1}{2}$ inches in length, and are able to provide for their own subsistence.

As food.—Generally held to be coarse and only eaten by the poor, but Lowe says it tastes much better and fatter than other Blennies. Neill states it is often brought to the Edinburgh market. At St. Andrew's a most intelligent mechanic informed me that no better fish could be obtained. As observed by Parnell, some consider its flesh as very fine and wholesome, while others consider it dry and disagreeable. When boiled the backbone becomes of a greenish colour.

Habitat.—From the seas of northern Europe, Scandinavia, the Baltic, German Ocean, and round the British shores to France, Portugal, and Spain. It has likewise been recorded by Kner from the coast of Decastris Bay.

Orkneys and Zetland, very common (W. Baikie): Moray Firth, Banff (Edward): Aberdeen (Sim): St. Andrew's (McIntosh): Firth of Forth (Parnell): Berwick (Johnston). Northumberland (Thompson), the whole of the Yorkshire coast: Greenwich (Yarrell). Along the south coast it is common in Hampshire (Barron), but becomes very rare to the westward, only one example having been recorded from Devonshire. Ireland, in county Down one example has been captured (Templeton).

The example figured natural size was from the coast of Sussex. It attains to at least two feet in length.

* Although pyloric appendages have been universally considered absent in this species, I have found them in the various British examples which I have examined. They are short but wide, and may be detected by inflating the intestines by means of a blow-pipe.

Family, XXII—CEPOLIDÆ, *Bleeker.*

Branchiostegals six: pseudobranchiæ present. Body elongated, low, and compressed. Eyes large and lateral. No bony articulation between the infra-orbital bones and the angle of the preopercle. Gill-openings wide, the membranes being scarcely united under the throat. Teeth in the jaws of medium size and pointed. A long spineless dorsal and anal fin, more or less continuous with the caudal. Ventral thoracic, with one spine and five rays. Scales cycloid, small. Pyloric appendages few.

Genus I.—Cepola, *Linnæus.*

Acanthocepola, Bleeker.

Head obtuse. Cleft of mouth oblique, its gape wide. Preopercle more or less armed. Palate edentulous. Air-bladder large.

Bleeker instituted Genus *Acanthocepola* for those forms which have scales on the head, the preopercle denticulated or spinate, and the body covered with imbricate scales.

Marine forms, which on the British coast vary in their rarity, mostly scarce but in some years pretty numerous.

Geographical distribution.—From the seas of temperate Europe through those of India to China and Japan.

1. Cepola rubescens, Plate LXII.

Serpens rubescens, Rondel. xiv, c. 8, p. 410; Gesner, p. 863; Willughby, p. 118, c. 13. *Myrus alter*, Aldrov. iii, c. 28, p. 367; Jonst. t. v, f. 5. *Taenia rubra*, Will. p. 117; Ray, Syn. p. 71. *Tænia*, no. 3, Artedi, Synon. p. 115. *Red band-fish*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 285.

Cepola rubescens, Linn. Syst. Nat. i, p. 445; Bl. Schn. p. 241; Gmel. Linn. p. 1187; Montagu, Trans. Linn. Soc. vii, p. 291, pl. xvii; Bonn. Enc. Ich. p. 57, pl. xxxiii, fig. 122; Shaw, Zool. iv, p. 190; Walb. Artedi, iii, p. 117; Brünn. Ich. Mass. p. 28; Donovan, Brit. Fish. v, pl. cv; Turton, Brit. Fauna, p. 94; Risso, Ich. Nice, p. 154, and Europ. Mérid. iii, p. 294; Yarrell, Brit. Fish. (Ed. 1) i, p. 195, c. fig. (Ed. 2) i, p. 224 (Ed. 3) ii, p. 305; Flem. Brit. An. p. 204; Thompson, M. N. H. (2) 1838, ii, p. 214, and Nat. Hist. Ireland, iv, p. 97; Couch, Trans. Linn. Soc. xiv, p. 76; Cuv. and Val. x, p. 388, pl. ccc; Harvey, P. Z. S. 1838, p. 45; Swainson, Fishes, ii, p. 259; Jenyns, Man. p. 374; Guichen. Expl. Algér. Poiss. p. 65; White, Catal. p. 54; Günther, Catal. iii, p. 486; Steind. Ich. Span. u. Port. 1868, p. 19; Canestr. Faun. Ital. p. 192; Giglioli, Pesc. Ital. p. 33; Moreau, Poiss. France, ii, p. 552, c. fig.

Cepola tænia, Linn. Syst. Nat. i, p. 445; Bl. v, p. 103, pl. clxx; Bl. Schn. p. 241; Shaw, Zool. iv, p. 187, pl. xxvi; Lacép. ii, p. 526; Walb. Artedi, iii, p. 117; Risso, Ich. Nice, p. 153.

Cepola serpentiformis, Lacép. ii, p. 529.

Cepola longicauda, Swain. Fishes, ii, p. 399.

Red snake-fish, Couch, Trans. Linn. Soc. xiv, p. 76.

Red band-fish, Couch, Fish. Brit. Isles, ii, p. 262, pl. cxx.

B. vi, D. 67-74, P. 12-15, V. 1/5, A. 60-70, C. 12, Cœc. pyl. 8, Vert. 15/54.

Length of head $10\frac{1}{2}$ to 15 : of caudal fin $10\frac{1}{2}$, height of body 15 to 19 in the total length. *Eye*—large, diameter 1/3 of the length of the head, 1/2 a diameter from the end of the snout, and 2/3 of a diameter apart. Snout short : cleft of mouth very oblique : lower jaw the longer : the maxilla reaches to beneath the middle of the eye. No spines on the preopercle. *Teeth*—in jaws largest anteriorly, they are pointed and curved inwards at their outer extremities, the number and even position of the teeth in the jaws varies in different specimens, from 24 to 41 having been recorded as existing in the upper, and from 16 to 25 in the lower jaw, behind which row are generally two more teeth : none on the vomer, palatine bones, or tongue. *Fins*—dorsal spineless, it commences above the last third of the opercle, it and the anal confluent with caudal, which latter is somewhat pointed. The anal commences beneath the tenth or eleventh dorsal ray. All the rays of the vertical fins articulated and branched. *Scales*—minute, thin, oval, but increasing in size towards the tail. Vent beneath a vertical line from about the ninth or tenth dorsal ray. *Air-bladder*—large, pointed in front, rounded behind. *Colours*—reddish, or even carmine, dashed with yellow, more especially on the fins. A black spot between the maxilla and premaxillary bones. Dorsal of a yellowish tinge edged with rose-colour. Pectorals deep rose colour, ventrals white.

Varieties.—*C. rubescens* is said to possess one, *C. tænia* two rows of teeth in the lower jaw. Couch alludes to a small example being almost round, but such is not their normal form, being comparatively as compressed as adults.

Names.—*Red band-fish* or *red snake-fish*, owing to its colour, appearance, and movements. *Le serpent de mer*, French.

Habits.—Appears to prefer rocky situations at a moderate depth, and to be most frequently observed off the British coasts after gales in or between the months of November and March. Dr. Farran observing that this fish is of frequent occurrence on the Waterford coast, remarks that it lives lying in the forests of sea-weeds which grow about the coast. It probably lives in deep water on rocky ground. Risso observes that it feeds on crustacea and zoophytes. It moves in a serpentine manner and with considerable activity.

Means of capture.—Seldom taken in nets as it is believed to swim too low, but is often washed ashore after a storm. In a few instances it has been secured on a hook.

Breeding.—At the end of spring according to Risso.

As food.—Not held in any estimation except by fish. It has been several times found inside cod and hake.

Diseases.—From the example figured I sent some intestinal parasitic worms to Dr. Spencer Cobbold, F.R.S., who kindly determined them as follows : immature examples of *Nematoideum Cepolæ rubescentis*, "six different internal parasites have been described from this fish. Those you send are probably the most common."

Habitat.—From the coasts of Great Britain and Ireland to the Mediterranean, where it is common.

On March, 1837, one, $15\frac{1}{2}$ inches long, was taken on a whiting line baited with mussel, seven miles south of Ayr (T. Harvey), and on November 29th, 1837, an example, $19\frac{1}{2}$ inches long, was, after a storm, found on the beach at Ballantrae, Ayrshire (Thompson) : Berwick (Johnston). Mr. Cordeaux observes that it has been thrown ashore in Yorkshire after storms, but the most numerous examples have been secured along the south coast. The first two British specimens were obtained by Colonel Montagu at Salcombe Bay, in Devonshire, February and March, 1803 : one, 22 inches long, was likewise captured on March 6th, 1838, in the Exe, and many (at least thirty) were washed on shore on the south coast of Devonshire during November the same year (Harvey), and more again in February, 1839, it became abundant at Brixham (Holdsworth), but has not been so common since. It has been taken a few times at Teignmouth

and Kingsbridge. On February 22nd, 1879, one, 19½ inches long, was captured at Exmouth when pursuing sprats (D'Urban, Zool. p. 183), and on November 16th, 1875, another was taken at Plymouth (Gatcombe, Zool. 1875, p. 4767). Mr. Dunn has recorded it from Mevagissey, and though Couch alludes to having obtained some examples he does not say they were from Cornwall. Mr. Cornish (Cornish Fauna, p. 39) observes on having heard of its capture, but never saw a Cornish example.

Ireland on the south and west coasts frequently taken on the latter (Andrew's). After a heavy gale in December, 1848, one was thrown ashore at Stradbury, in Queen's County (Farran): several specimens in the Dublin University Museum have been received from the west coast captured by Professor Melville.

For the example figured I am indebted to the late Frank Buckland, Esq.: it was captured at Exmouth in March, 1879. The longest recorded British example was 22 inches.

Ninth group—Acanthopterygii tæniiformes.

Body riband-shaped. Dorsal fin extending the entire length of the back: anal absent: caudal, when present, rudimentary, or not in the longitudinal axis of the body.

Family, XXIII—TRACHYPTERIDÆ (part), *Swainson.*

Tænioidei, pt. Cuvier. *Gymnetridæ*, Gray.

Branchiostegals six: pseudobranchiæ present. Body elongated and strongly compressed. Gill-openings wide: gills four. Eyes lateral. Cleft of mouth slight. Dentition feeble. A single dorsal fin occupying the whole length of the back, and which may have a detached anterior portion, the whole composed of rays which are neither articulated nor branched. Anal absent. Caudal not in the longitudinal axis of the fish or else rudimentary: ventrals, when present, thoracic. Scales absent. Pyloric appendages numerous. Vertebræ many. Bones soft.

Among the fishes occasionally taken off the British coasts, there are few pelagic or abyssal forms that have given rise to so many theories and conjectures as the "riband fishes." While their life history, and even their very external appearance are not thoroughly elucidated. Generally of a brilliant silvery lustre they have been mixed up with the similarly coloured *Trichiuridæ*, of which we possess species of two genera, *Lepidopus* and *Trichiurus*, already described (pp. 153, 156). Some have been credited with being the veritable sea serpent (see *Regalecus*, page 223) both while in the ocean and also when observed in a pool on shore. One form at least (see *Trachypterus*, page 219) is a slow swimmer and lies at the bottom of the sea reclining on one side as occurs in the flat fishes (*Pleuronectidæ*). None have been recorded as captured by the deep sea dredge, but their remains are by no means rare. The difficulty of obtaining unmutilated specimens is very great, due to the brittleness of their bodies, the fragility of their rays, and the soft character of their thin and porous bones. While their soft flesh rapidly decomposes after death. Many young ones are said to have been taken near the surface.

The British genera as at present known are restricted to 1, *Trachypterus*, caudal fin present: 2, *Regalecus*, caudal fin absent.

Professor Gill likewise suggested that a Cuban fish belonging to a recently recognized genus, *Euoxymetopon*, might be identical with an example captured in Scotland in 1812, and Dr. Günther, in his Introduction to the Study of Fishes, 1880, observes at page 435 respecting the genus *Euoxymetopon* that "a specimen has been known since the year 1812: it was found on the coast of Scotland and described as *Trichiurus lepturus*." At page 221 I have given my opinion that the fish alluded to is a *Regalecus*, and cannot be identical with the new West Indian form.

Geographical distribution.—Abyssal forms found to very high latitudes and most numerous in the Atlantic, Mediterranean and North Pacific Ocean. While a solitary example has been taken on the coast of India: also at the Mauritius and Eastern Pacific, as well as off New Zealand and the west coast of South America.

Genus I.—Trachypterus, *Gouan.*

Bogmarus, Bl. Schn. *Gymnogaster*, Brünnich.

Definition as in the family, with each ventral well developed if present, but sometimes absent. Caudal fin present, and placed mostly above the longitudinal axis of the body. No air-bladder. Pyloric appendages numerous.

The ventral fins, as originally remarked, appear to be absent in some specimens, and the genus *Gymnogaster* was instituted for the reception of such forms. That this fin is mostly present seems to have been proved, but not so among such examples as have been taken along the coasts of Great Britain. Still it is an open question whether its absence may not be the result of age, a mark of sex, or due to some other cause, under which circumstances I have deemed it best to leave names as they are* and await future specimens being obtained for examination. In the very young of the known forms the first few dorsal rays are very prolonged, often considerably longer than the body, while along their edges at irregular distances are short projections on either side: the ventrals likewise are very elongate, and the caudal rays much longer than in adults.

It is stated by Olafsen that in Iceland these fishes are considered venomous, as ravens do not touch them, but as Mr. Reid observed the lesser black backed gull will eat them at Orkney, this statement appears to be doubtful, more especially as Duguid on the authority of Mr. Strang says, that they are occasionally used as food by the natives of Orkney. Panceri (Rend. Acc. Napol. 1871, April) remarks that the fat of *Trachypterus iris* is phosphorescent.

Geographical distribution.—North Atlantic Ocean, especially off the coast of the Orkneys, and the North Sea coast of Scotland to Yorkshire, and the Atlantic coasts of Europe and the Mediterranean. It has also been taken at Valparaiso and the Mauritius.

1. Trachypterus Arcticus, Plate LXIII.

Vogmeri or *Vaagmär*, Olafs. Island Reise. § 684, t. xliii.

Gymnogaster arcticus, Brünn. Nye Saml. Dansk. Vid. Selsk. Skr. iii, p. 408, t. B, f. 1-3; Faber, Fische Isl. p. 66; Nilss. Prod. p. 107; Walb. Artedi, iii, pl. iii; Fleming, Mag. Nat. Hist.† iv, 1831, p. 215, c. fig.; Swainson, Fishes, ii, p. 258.

Bogmarus islandicus, Bl. Schn. p. 518, t. ci.

Gymnetrus arcticus, Cuv. Règne Anim.; Jenyns, Brit. Vert. p. 372.

Trachypterus bogmarus, Cuv. and Val. x, p. 346; Yarrell, Brit. Fishes (Ed. 1) i, p. 191, c. fig. (Ed. 2) i, p. 210 (Ed. 3) ii, p. 282; Duguid, Proc. Zool. Soc. 1851, p. 116; Gaimard, Voy. Isl. et Grönl. Zool. Poiss. pl. xii; Collett, Norges Fiske, p. 78; Winther, Ich. Dan. Mar. p. 24.

Trachypterus vogmarus, Reinh. Vid. Selsk. Skr. vii, D. p. 65, c. fig.; Lilljeborg, Ofvers. af. Vet.-Akad. Förh. 1849, p. 33; Kröyer, Dan. Fiske, i, p. 292; Report Montrose Soc. 1873, p. 4, with a photograph.

Vogmarus islandicus, Reid, Ann. and Mag. Nat. Hist. (2) iii, 1849, p. 456, pl. xvi.

Trachypterus arcticus, Nilss. Skand. Fauna Fisk. p. 162; Duguid, Proc. Zool. Soc. 1851, p. 116; Günther, Catal. iii, p. 305; Collett, Norges Fiske, p. 78, and Christ. Vid. Selsk. Fordh. 1879, No. 1, p. 59.

Deal-fish, Couch, Fish. Brit. Isles, ii, p. 246, pl. cxviii.

B. vi, D. 158-165 (172), P. 5 (10-11), V. 0 (6). C. 7-8.

* While investigating this question I have been to the Newcastle and Montrose Museums, and also to Norwich, where I examined the example captured there in 1879.

† I must draw particular attention to no ventral fins having been present in the three British examples which I have seen, namely, at Montrose, Newcastle, and Norwich, and from which my figure was made and my description taken.

Length of head $9\frac{1}{2}$, of caudal fin $9\frac{1}{2}$, height of body 6 in the total length. *Eye*—lateral, diameter 3 in the length of the head, 1 diameter from the end of the snout, and 1/2 a diameter apart. (In an example captured at the Orkneys in 1817 the height of the body was $6\frac{3}{4}$ in the entire length.) Body very strongly compressed: its height continuing much the same to within the last fourth of the length of the body, when it suddenly decreases and becomes very low at the caudal peduncle. *Teeth*—small (in the maxilla nearly recumbent, thin and pointed, with the apices pointing towards the pharynx: two on either side of the upper jaw: three or four on each side of the lower: one or two teeth on the vomer, but none on the palatines in *T. arcticus*). *Fins*—the dorsal commences above the posterior end of the opercle, its rays are simple and not articulated: its first few are low (no anterior elongated portion as described in *T. arcticus* exists). The fin gradually becomes higher, attaining its greatest elevation in the posterior fourth of the length of the back, but gradually diminishes in height as it approaches the caudal fin, on to which it is not continued. Pectorals very short, situated low down and close to the head, and with five rays (10-11 in *T. arcticus*). No ventrals (said to exist in *T. arcticus* and to consist of six rays, Dr. Duguid also observed minute ones in some Orkney examples). Caudal with seven minute rays at Montrose, eight in that at Norwich, it is situated slightly above the longitudinal axis of the body: close to its base and on the inferior edge of the caudal peduncle exists a short spine pointing forwards, and three or four smaller ones behind it (some have supposed this to be a rudimentary anal fin). Vent situated midway between the hind edge of the eye and the base of the caudal fin. *Lateral-line*—almost straight, and slightly nearer to the abdominal than it is to the dorsal profile: it consists of a row of oval bony plates having a central spinate prolongation to each, and which increase in size towards the tail. Some hard warts exist along the edge of the abdomen. *Colours*—silvery, with indications of light longitudinal lines, but no black spots (as stated to exist in *T. arcticus*). Fins red, the caudal tinged with darker.

The foregoing descriptions are taken from the three specimens I have personally seen at Norwich, Newcastle, and Montrose. Whether the first of these had or had not a ventral fin appears doubtful. Mr. Southwell observes that "Mr. Rump, who first saw it, says it had two singularly rounded fins at the V." (ventral); but when he examined it "the ventral fins mentioned by Mr. Rump had disappeared." Reinhardt found them in both examples of *T. arcticus* from Iceland which he examined. I could not see any indications of them. There was no anterior dorsal fin consisting of elongated rays, while "Mr. Cole tells me that it was a male" (Southwell). These British forms would appear to be identical with Professor Lilljeborg's specimens sent from Tromso to Nilsson who considered it might be distinct from *T. arcticus;* but Dr. Duguid, having observed minute ventrals in some Orkney examples, renders it possible that all may belong to one species.

In a paper upon the different species of this genus, and especially on the metamorphoses of *T. tænia*, C. Emery* comes to the conclusion that *T. filicauda*, Costa; *T. spinolæ*, Cuv. and Val.; *T. tænia*, Bloch; and *T. iris*, Walb., are names given to the successive stages of one and the same species, viz., *T. tænia*. He gives particulars of twenty-three specimens which he had examined.

Professor Gill, with great probability, suggests that Hoy's fish, found Nov. 2nd, 1810, and described as *Trichiurus lepturus* (Trans. Linn. Soc. xi, p. 210) was apparently a *Trachypterus*, the height of the body equalling about six in the total length; its greatest thickness being only one inch, &c.

Names.—Deal-fish, due to its thin form. *Vaagmaer*, from its Icelandic name.

Habits.—Olafsen says (Voy. Iceland, p. 592) that it is rare even in Iceland: it seems to approach the shore at the flood tide in places where the bottom is sandy and the shore not steep, and here it remains until left dry. Nilsson remarks that it is termed *Sölv queite* or "Silver holibut," its name signifying its colour,

* Atti Acc. Rom. (3) Mem. Sci. Fis. iii, pp. 390-395, fig. 1-6, and Mt. z. Stat. Neap. 1879, i, p. 581.

and that its habits resemble those of flat-fishes. Some are thrown ashore after storms, a few are taken during the autumn in the herring nets; but at other seasons they are believed to frequent deeper waters. They have been seen at the bottom in two or three fathoms of water where the fishermen hook them up with the implement employed to raise dead seals. They move something like a flat-fish, with one side turned obliquely upwards, the other (the left) being towards the ground. The Finland fishermen say that when alive it is very fat and its sides round; but the fat is so liquid and oily that it runs from the body as soon as the fish dies. The Russians at Archangel are said to purchase them for the fat they contain.

As food.—Observed by Mr. Strang to be eaten in the Orkneys.

Habitat.—From Iceland to the Orkneys and shores of the British Isles.

Fleming describing one from the island of Sanday in the Orkneys, taken in 1829, quotes a letter from Dr. Duguid, who observes: "Mr. Strang tells me that two or three specimens have been found on the shores of the island this winter, as well as on former occasions, and in 1851 that he had obtained seven or eight since 1829: on the whole, however, they are of rare occurrence." December 2nd, 1817, one $4\frac{1}{2}$ feet long was found on the beach at Sanday by Mr. Lindsay: 1847, one 3 feet long at Burghhead, Moray Firth (Martin), where Dr. Gordon, Zool. p. 3460, alludes to the capture of two. April, 1872, one 5 feet $10\frac{1}{2}$ inches long was captured in the stake nets at Montrose, and is now in the Museum: Mr. Reid, of Wick, mentions having obtained three specimens (Buckland); also in 1849, one in the Firth of Forth. In January 18th, 1844, one 3 feet 5 inches long was obtained on the coast of Northumberland and placed in the Newcastle Museum. April 7th, 1848, one was found dead at Elie, but quite fresh (D. 176). On October 8th, 1879, one 53 inches in length was taken by a fisherman in a draught net in Holkham Bay, on the Norfolk coast (Southwell), it is now in the Norwich Museum.

In Ireland.—One 7 feet 9 inches long: tail only 5 inches: greatest depth $15\frac{1}{4}$ inches; greatest thickness $2\frac{1}{2}$ inches, was washed ashore at Bundoran on the southern shore of Donegal Bay in 1875 (Zool. Feb. p. 4343).

The figure on plate lxiii is taken from the specimen in the Montrose Museum, which is 5 feet $10\frac{1}{2}$ inches in length. The longest British example recorded is $7\frac{3}{4}$ feet long, but the fish is said to attain to several feet more.

Genus II.—Regalecus, *Ascanius.*

Gymnetrus, Bl. Schneider.

Definition as in the family, with each ventral in the form of a single long filament, which may possess a dilated extremity. Caudal fin, if present, rudimentary (except in the Asiatic species). No air-bladder. Pyloric appendages numerous.

Geographical distribution.—The *Regalecus* or "king of the herrings" has been captured in the seas of Northern Europe, extending to the coasts of the British Isles; in the Mediterranean; the South Atlantic; a single example off the coast of Vizagapatam in the East Indies; New Zealand and New South Wales.

It may be questioned if the species of this genus have not been unduly multiplied, and whether the difference in the height of the body as compared with its length may not be due to the influence of locality, of age, or of sex. Simply regarding variations in the number of the rays of the dorsal fin as indicating distinct species is rather a hazardous proceeding in a genus such as *Regalecus*, wherein the dorsal rays being numerous, a very great latitude in the number must be anticipated, even among varieties of the same species.

1. Regalecus Banksii, Plate LXIV.

? *Gymnetrus Hawkenii*, Bl. xii, p. 88, t. 425; Lacép. iii, p. 380; (*Gymnetrus Hawkinsii*,) Bl. Schn. p. 481; Cuv. and Val. xii, p. 372; Jenyns, Brit. Vert. p. 373. Shaw, Zool. iv, p. 197; Couch, Trans. Lin. Soc. xiv, p. 77; Yarrell, Brit. Fish. (Ed. 2) i, p. 221, c. fig. (Ed. 3) ii, p. 302.

Gymnetrus Banksii, Cuv. and Val. x, p. 365; Hancock, Trans. Tyneside Field Club, i, 1849, p. 228, c. fig., Ann. and Mag. Nat. Hist. 1849, iv, p. 1, pl. i and ii; Tristram, Proc. Zool. Soc. 1866, p. 147, and Ann. and Mag. xvii, p. 312 and p. 390; Hogg, l. c. xviii, p. 136.

Gymnetrus —?, Martens, in Jacob's Account of Rare Fishes, 1849, p. 10.

Regalecus Banksii, Yarrell, Brit. Fish. (Ed. 3) ii, p. 293; Walker, Ann. and Mag. (3) 1862, x, p. 13; Günther, Catal. iii, p. 309; McIntosh, Fish. St. Andrew's, p. 176; Collett, Norges Fiske, p. 87.

Trichiurus lepturus (part) Hoy, Trans. Linn. Soc. xi, p. 210.

Regalecus glesne, Bonn. Ency. Ich. p. 40, p. lxxxvi, fig. 358; White, Catal. Fish. p. 40; Gray, Proc. Zool. Soc. 1849, p. 78, and 1850, p. 52.

Banks' oar-fish, Couch, Fish. Brit. Isles, ii, p. 251, pl. cxix.

Ribbon-fish, T. Wright, Nat. Hist. Trans. North. and Durham, 1877, v, pt. iii, p. 340.

B. vi, D. $\frac{10\text{-}15}{226\text{-}290}$, P. 11, V. 1.

Length of head 12 to 16, height of body 13 in the total length. *Eye*—5 diameters in the length of the head, and nearly 2 diameters from the end of the snout. Body much compressed, its greatest thickness being nearer to the ventral than to the dorsal profile. The height of the body is less opposite and just behind the gill openings than it is further back, but the rise is very gradual, while it gradually diminishes again in the last half of its extent. Forehead very steep: snout truncated: the cleft of the mouth almost vertical, but when closed the posterior extremity of the maxilla reaches to beneath the front edge of the eye. The greatest height of the head equals its length excluding the snout. The caudal termination is more difficult to make out in such examples as I have seen—all but the Newcastle one being stuffed. When first examined "the edge of the back behind the termination of the dorsal fin sloped rapidly downwards to within an inch of the line of the belly, and then formed a rounded point, which is the distal extremity of the fish. Both the upper and under edges of this extremity were very thin, and the fishermen insisted that when they took

the fish this part was entire, and that there was no tail fin whatever. The edges could be pressed together, and seemed to fit" (Hancock). *Teeth*—absent. *Fins*—the dorsal commences on the forehead above the middle of the eyes: its first ten or twelve rays are produced even in females, exceeding the greatest height of the fish in length, the anterior ones being higher than the posterior ones; they are connected by a membrane which is continued along the entire extent of their posterior surface, and end superiorly in a cutaneous lobe. The remainder of the rays of the dorsal fin are of an almost uniform height at first, but decrease considerably in the last portion of the fin. Pectoral situated rather nearer the ventral surface of the body than to the lateral-line, its rays simple and short. Ventral consists of one long spine, equalling about one-third of the entire length of the fish, along the inner margin of which the membrane is continued, and ends posteriorly in a cutaneous lobe.* Caudal absent. Skin covered with a silvery deciduous pigment, which under the microscope appears like the scales on the wing of a moth. The skin is studded with numerous bony tubercles, irregularly arranged, replaced near the head by depressed indurations. Four indurated ridges pass along the body above the lateral-line. Along the lower edge of the body are numerous rough tubercles. *Lateral-line*—descends gradually from above the eye to the middle of the body, and is continued to its caudal extremity. *Stomach*—elongated and dividing posteriorly is continued backwards between the muscles to within a short distance of the caudal end of the fish. *Colours*—"uniform silver-gray all over, resembling bright tin-foil or white Dutch metal, except a few irregular dark spots and streaks towards the anterior part of the body. On closer inspection the remains of a bright iridescence were seen about the pectoral fins and head, the blue tint predominating" (Han. &c.). Round the posterior margin of the preopercle a broadish dusky mark on the skin, and near the top of the head above the eye a crescentic mark of a dark iridescent blue colour; besides those on the side of the body there were several narrow, dusky black, slightly waved lines considerably apart from each other, and obliquely inclined from before backward, eight being above the lateral-line, but more numerous below it, also some spots.

The Amble specimen, according to Mr. Wright, was 13 feet $4\frac{1}{2}$ inches long. Its height at the gills was about $10\frac{2}{3}$, and in its deepest part near the middle of the fish 11 in the total length. Its greatest thickness one-third of its height. Dorsal rays 236, connected by a thin and delicate membrane. The first ten rays were much longer than the rest, and formed quite a crest: the first was 24 inches long, the others were broken. Pectoral 11 rays, and each ventral a very long and spine-like ray 4 feet long, with a small oval, leaf-like expansion at its end. Vent nearly 6 feet from the end of the snout. Eye $1\frac{1}{2}$ inches in diameter. Mouth very protrusible. No teeth observed in the jaws.

November 12th, 1812, a fish was found on the beach on the shores of the Moray Firth, which Hoy considered to be *Trichiurus lepturus*, and described as follows. Its head had been broken off and was quite gone: a small bit of the gills only remained about the upper part of the throat, from whence to the extremity of the tail its length was 12 feet 9 inches: its breadth (height), $11\frac{1}{4}$ inches, was nearly equal for the first 6 feet in length from the gills, diminishing gradually from thence to the tail, which ended in a blunt point, without any of those bristles which projected from the tail of the one found formerly: its greatest thickness was $2\frac{1}{2}$ inches: the distance from the gills to the anus 46 inches. The dorsal fin extended from the head to the tail, but was much torn and broken: the bones and muscles to which the pectoral fins had been attached were perceivable very near the gills. There were no ventral nor anal fins, but the thin edge of the belly was closely muricated with small hard points, which, though scarcely visible through the skin, were very plainly felt all along it. Both sides of the fish were white, with four longitudinal bars of a darker colour: the one immediately below the dorsal fin was about 2 inches

* Professor Collett observes (MSS.) that his impression is that in the example he examined, a cutaneous membrane extended along the entire inner side of the ventral spine, ending in three lobes, each distinct and pointed.

broad, each of the other three about three-fourths of an inch. The side (lateral) line straight along the middle." Gill (Proc. Ac. Nat. Sc. Phil. 1863, p. 228, and 1864, p. 205) observes "it is true that Hoy denies ventral and anal fins, but it must be remembered that he was not a scientific ichthyologist; the ventral scales, as well as the anal fin, had also perhaps been lost, or preoccupied with the idea that his fish was the *Lepturus* (*Trichiurus*) Hoy did not carefully look for them. But whether this hypothesis is right or wrong, it is evident that Hoy had neither a *Lepturus* (*Trichiurus*) nor *Lepidopus* before him." Even admitting Hoy's account to be less accurate than could be desired, we must observe as follows:—the head having "been broken off and quite gone" the ventrals may have shared the same fate, more especially as of the pectoral fins only "the bones and muscles to which they had been attached were perceivable." There was no anal fin, and the tail "ended in a blunt point," while "the thin edge of the belly was closely muricated with small hard points." All the foregoing are identical with what exists in *Regalecus*. On the other hand, in *Euoxymetopon* an anal fin is present; the tail ends in a well-developed forked fin, and the edge of the belly is smooth. The colours in the two forms seem to be much the same.

Gymnetrus Hawkenii, Bloch, appears to be this fish, which was taken at Newlyn close to Penzance, and incorrectly delineated. Mr. T. Cornish, of Penzance, observes that on the walls of a cottage in the neighbourhood has been discovered the drawing of one of these fish, having the following inscription—"*Hawkins gymnetrus*," the *Ceil conin*, or "king of the herrings. This very remarkable fish came on shore (alive) at Newlyn, on Saturday, Feb. 23rd, 1788. Its length without the tail (which it wanted) was $8\frac{1}{2}$ feet. Its breadth $10\frac{1}{2}$ inches: thickness $2\frac{3}{4}$ inches: and weight 40 lb." (Cornish Telegraph, 1870). Mr. Cornish also observes that there is a trace but not a record of its occurrence, once subsequently at Marazion in Mount's Bay.

Varieties.—It is open to question whether more than one form of *Regalecus* has not been obtained on our shores; or if the differences which have been remarked upon may not be due to age or accident. Professor Collett (Norges Fiske) has expressed a doubt on this subject, believing that the three forms *R. glesne*, *Banksii*, and *grillii* are hardly identical. The following are the differences given, which possibly may not be specific but merely within the limits of variation:—

1. *Regalecus glesne* or *Ophidium glesne*, Ascan. *R. remipes*, Brün. D. 8/126-160, P. 14, A. 1.

2. *Regalecus grillii*, or *Gymnetrus grillii*, Lindr. D. 406, P. 12, V. 1. Height of the body 15, length of the head 18 in the total length.

To this latter species Dr. Günther thinks Hancock's specimen taken in 1845 may be referred. An example taken near Whitby in Yorkshire, the last week in January, 1880, was 16 feet long, the length of the head 19, and the height of the body from 19 to 24 in that of the total length. The number of rays was not given. It was left among the rocks by a retiring tide, and in its struggles to escape it broke itself into three parts (C. Elliott, in the Field). This from the proportions would seem to agree with the variety *R. grillii*. Dr. Gray observed (1849) "I believe there is only a single species yet found in the North Sea."

Names.—*Banks' oar-fish*, after Sir J. Banks and its oar-like appearance.

Habits.—The haunts of this fish are little known, but those which have been secured are supposed to have left their usual deep sea home due to disease or injury, or may be for depositing their ova; while being so fragile they must habitually reside where storms are unknown. Their movements are undulating and rapid, consequently when they appear occasionally at the surface leaving a lengthened wave behind, an exaggerated idea of their length is given, thus rendering it possible they may have been one of the supposed forms attributed to the "sea serpent."

Respecting the example secured at Amble, opposite Coquet Island, March 3rd, 1876, Mr. Wright observes that when it got into shallow water it turned to make out to sea again, but a man who saw it ran into the water and seized it by the gills, and with some extra help it was dragged on shore. It was stated to

have lived two hours after being landed. Its tail was damaged by lashing against the rocks when the fish was captured.

One was observed off Northumberland, March 26th, 1849, about 6 miles from shore in 20 or 30 fathoms of water, but lying on its side at the surface. "The fish as they approached righted itself, and came with a gentle, lateral, undulating motion towards them, showing its crest and a small portion of the head occasionally above water; when it came alongside, one of them struck it with his picket—a hook attached to the end of a small stick, and used in landing their fish; on this it made off with a vigorous and vertical undulating motion, and disappeared as quick as lightning under the surface. In a short time it reappeared at a small distance, and pulling up to it they found it again lying on its side; they plied the picket a second time and struck it a little behind the head; the picket again tore through the tender flesh by a violent effort of the fish, which escaped once more, but with diminished vigour; on the boat coming a third time alongside, the two young men putting their arms round the fish lifted it into the boat. Signs of life remained for some time after the fish was captured, but no doubt it was in a dying or very sickly state when first discovered" (H. Hancock and D. Embleton, Ann. Nat. Hist. (2) 1849, iv, p. 1). From an examination of the contents of the stomach they were led to conclude that its habitual food had been confined to the spawn of other fish, and the soft, small, defenceless inhabitants of the deep.

Breeding.—The example taken in April, 1866, was found by Mr. Martin Simpson to be a female near to spawning time.

The following are most of the specimens which have been recorded as British, others have been mentioned, but the authority in some at least appears questionable.

March, 1844, an example 12 feet long was secured at Crovie, near Macduff (Marten): Couch alludes to one 15½ feet long, which Mr. Peach informed him had been captured at Kiess, a few miles from Wick: in July, 1877, one 12⅓ feet long at Dunnet Bay, Caithness, where it came ashore alive during calm weather (Buckland): September 17th, 1851, one 11 feet 10 inches long in the Bay of Cromarty (G. Gordon, Zool. 1851, p. 3660): August 21st, 1880, one 12 feet 9 inches long was found dead, but quite fresh and uninjured, at the mouth of the Eden, on the sands at St. Andrew's: it has been stuffed and restored and is now in the Museum. March 27th, 1794, one 10 feet 1 inch long was shown at Newcastle: March 8th, 1876, one 13¼ inches long was taken at Amble, opposite Coquet Island (T. Wright): in 1800 two were captured at the outer Fern Islands, 14 and 18 feet respectively in length: March 18th, 1796, one 13 feet long was taken by four women at Filey (Banks): in 1845 one 16 feet long was found alive in a pool near Alnmouth by one of the Preventive Service Men. On his approach it bent its body into a circle, and he, ignorantly thinking that it was going to spring upon him, attacked it with his cutlass and cut off its head (Hancock): March 2nd 1866, one 14 feet long, and not quite dead, was thrown ashore at West Hartlepool after a storm (Tristram): March 26th, 1849, one 12¼ feet long at Cullercoats, and is now in the Newcastle Museum (Hancock): in 1850, January 3rd, one 10 feet 11 inches long was taken alive at Redcar (Zoologist): April 23rd, 1866, one 10 feet long was taken in Yorkshire, and is now in the Whitby Museum (Stephenson in the Fauna of Yorkshire): October 2nd, 1870, one 11 feet long, also from Yorkshire, is now in the Whitby Museum (l. c.): January, 1880, one 16 feet long at Staithes, Yorkshire (C. Elliot, Field, February 7th, 1880). January 22nd, 1759, one 11⅓ feet in length was taken off Whitby (Annual Register): February 23rd, 1788, one 8⅓ feet long was taken at ebb tide on the sands at Newlyn, Mount's Bay, Cornwall, and of which several copies appear to have been made, but with varying dates attached.

The figure on plate lxiv is from the Newcastle specimens, and with assistance received from Mr. Wright, the curator of the Museum.

Tenth group.—Acanthopterygii mugiliformes.

Two separate dorsal fins, the anterior short, or else composed of weak spines. Ventrals abdominal, with one spine and five rays.

Pallas, Cuvier, and others have pointed out the close relationship which exists between the Atherines and the Mullets.

Family, XXIV—ATHERINIDÆ, *Günther.*

Branchiostegals five or six: pseudobranchiæ present. Four gills: gill-opening wide. Body more or less elongated and somewhat subcylindrical. Eyes lateral. Gape of mouth of moderate width: cleft not very deep. Teeth minute. Two separate dorsal fins, the first with feeble spines, and less in number than the rays of the second, which is similar to the anal: ventral abdominal, with one spine and five rays. Scales cycloid and of medium size. Lateral-line indistinct. Pyloric appendages, when present, few. Air-bladder present.

Geographical distribution.—These pretty little fishes, furnished with a burnished silvery lateral band, are distributed throughout nearly all the seas of temperate and tropical regions. They are not only taken in the littoral region, but even in estuaries and tidal rivers when not far removed from the sea, while some have been acclimatized in fresh waters.

Genus I.—Atherina, *Artedi.*

Pseudomugil, Kner.

Branchiostegals five or six: pseudobranchiæ present. Body somewhat subcylindrical, with slightly compressed sides. Snout more or less obtuse: cleft of mouth oblique, extending to as far as below the front edge of the eye. Teeth very minute, but usually present on jaws, palate, and tongue. Ventrals at some distance behind the pectorals. Scales of moderate size. Air-bladder present. Pyloric appendages, when present, few. Ova comparatively very large. A silvery lateral band.

These are gregarious fishes mostly residing in the littoral regions, but whether more than one species exists on our shores is doubtful. Dr. Günther in his Catalogue (iii, p. 395) observes of *Atherina Boyeri* "according to Couch, occasionally on the coast of Cornwall," and in his Introduction to the Study of Fishes, he states, "*A. presbyter* and *A. Boyeri* occur on the British coast."* But no British example appears to exist in the national collection.

Atherina presbyter was reported by Meynell, in 1844, as taken in Bridlington Bay, Yorkshire. Montagu and Yarrell considered it absent from the east coast of England, where its place is filled by the true smelt, *Osmerus eperlanus*, which in its turn is asserted to be absent from the south coast. The foregoing, it would appear, cannot be accepted as literally correct if Gurney, who has reported it from Lowestoft, and Lowe from the Norfolk estuary, have not likewise been in error. It is evidently rare on the east coast, which may be due to the nature of the ground, or absence of appropriate food. In the Field, May 21st, 1881, it is observed "Sand smelts run larger in Cornish deep water harbours than further east as a rule."

* Dr. Günther (Intr. Study of Fish. p. 500) observes of the Atherines, that "the young, for some time after they are hatched, cling together in dense masses, and in numbers almost incredible. The inhabitants of the Mediterranean coast of France call these newly hatched Atherines 'Nonnat' (unborn)"—(perhaps an observation from Cuvier and Val. x, p. 417.) But as such a phenomenon has not been observed on our shores, I may mention that the *nonnats* are a form of Goby, *Aphia pellucida*, see p. 169, ante.

1. Atherina presbyter, Plate LXV, fig. 1.

Duhamel, Peches, ii, sect. 6, pl. iv, f. 1-4, 7. Osbeck, Nov. Act. Nat. Cur. iv, p. 103, No. 22. *Atherine*, Pennant, Brit. Zool. (Ed. 1) iii, p. 328, pl. lxv. (Ed. 2) iii, p. 434, pl. lxxvi; Gronov. Zooph. No. 399, and Mus. Ich. p. 23, no. 66.

Atherina hepsetus, Donov. Brit. Fish. iv, pl. lxxxvii; Turton, Brit. Fauna, p. 105; Flem. Brit. Anim. p. 217; Yarrell, Zool. Journal, iv, p. 471 (not Linn.).

Atherina presbyter, Jenyns, Manual, p. 377; Yarrell, Brit. Fishes (Ed. 1), i, p. 214, c. fig. (Ed. 2) i, p. 229 (Ed. 3) ii, p. 170; Parnell, Wern. Mem. vii, p. 230, and Fishes Firth of Forth, p. 70; Cuv. and Val. x, p. 439, pl. cccv; Thompson, Proc. Zool. Soc. 1835, p. 80, and Nat. Hist. Ireland, iv, p. 106; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Lowe, Trans. Zoo. Soc. ii, p. 184; Guichen. Explor. Algér. Poissons, p. 66; Cuv. Règne Anim. Ill. Poiss. pl. lxxvi, f. 3; White, Catal. p. 26; Swainson, Fishes, ii, p. 243; Günther, Catal. iii, p. 392; Schlegel, Dieren Neder. p. 28, pl. ii, f. 5; Steind. Ich. Span. u. Port. 1868, p. 11; Ogilby, Zoologist, 1876, p. 4754; McIntosh, Fish. St. Andrew's, p. 176; Giglioli, Catal. Pesc. Italiani, p. 32; Moreau, Poiss. France, iii, p. 207.

Atherine, Couch, Fish. Brit. Isles, iii, p. 1, pl. cxxi, f. 2.

B. vi, D. 7-9/$\frac{1}{11\text{-}13}$, P. 13-15, V. 1/5, A. $\frac{1}{14\text{-}16(18)}$, C. 17, L. l. 57-62, L. tr. 10-11, Vert. 51.

Length of head $5\frac{1}{2}$ to 6, of caudal fin $5\frac{3}{4}$ to $6\frac{1}{4}$, height of body $5\frac{3}{4}$ to $6\frac{2}{3}$ in the total length. *Eye*—diameter $2\frac{3}{4}$ to 3 in the length of the head, 3/4 to 1 diameter from the end of the snout, and 1 diameter apart. Abdominal profile more convex than the dorsal. Cleft of the mouth oblique, the posterior extremity of the maxilla reaches to beneath the first third of the orbit: the lower jaw somewhat projects in front of the upper. *Teeth*—present in the jaws, vomer, palatines, and in a medium patch along the tongue. *Fins*—the first dorsal commences over the middle of the ventral fins, its second and third spines longest, equalling the highest rays of the second dorsal, and 2/3 of the height of the body below it. The second dorsal commences above the sixth anal ray. Caudal forked. *Scales*—on the opercles and cheeks. Cœcal appendages absent. *Colours*—semi-diaphanous, of an olive-brown along the back, becoming silvery tinted with purple, on the sides and beneath. Numerous fine black dots along the edges of the scales in the upper half of the body. A burnished silvery band, darkest superiorly, extends from the eye to the centre of the base of the caudal fin, it occupies the lower half of the fourth, the whole of the fifth and the upper half of the sixth row of scales in the anterior region of the body. Those in the north of Ireland are of a darker ground colour than those in England, and the spots above the lateral-line more numerous.

Jenyns observes in his description of some examples from the Sussex coast that they had fifty-one vertebræ, and the same number have been present in such as I have examined: the first twenty-five being abdominal and the remainder caudal. The lower apophyses of the anterior caudal vertebræ are curved so as to form a wide canal for the posterior process of the air-bladder; while the second to the seventh of them have also broad expansions protecting the canal. Taking thirty-one specimens from the south coast, I found the formula of the fin rays as follows: first dorsal seven spines in three, eight spines in twenty-four, and nine spines in four; the posterior one being delicate, is liable to be injured or overlooked. The second dorsal had one spine in all, and eleven rays in four, twelve rays in nine, and thirteen rays in eighteen. The anal had one spine in all, fourteen rays in five, fifteen rays in thirteen, sixteen rays in twelve, and eighteen rays in one.

Thompson found much the same number in the nine Irish examples which he described D. 7-8/$\frac{1}{12\text{-}15}$, A. $\frac{1}{15\text{-}18}$.

Varieties.—In form: Jenyns found the eye in some examples having fifty-one vertebræ, $2\frac{1}{2}$ diameters in the length of the head. *As to colour.*—Thompson observes that the atherine of the north of Ireland differs from the English specimens in being of a darker, and consequently a less sandy colour.

Names.—Smelt or *sand smelt*, where the true *Osmerus eperlanus* is unknown. A local name is *silver-sides*, from its colour. In Cornwall it was formerly termed *Quid*, a word signifying "white." *Pincher* at Portrush (Ogilby). *Portaferry*

chicken, north of Ireland (Thompson). *L'Athérine prêtre*, "pretre," as the silvery lateral band is considered to resemble a priest's stole; or *abusseau* or *rosére* on the Atlantic shores of France. *De Koornar-visch*, Holland.

Habits.—This appears to be rather a local species generally living in small communities along the shores, or in harbours or bays where the ground is rough and sandy, and the water smooth, retiring in winter to deeper water. Couch remarks that he had been informed of instances in the shallow waters of a harbour where numbers which had been surprised by a sudden frost had been left dead on the shore. It eats small crustacea and vegetable matter.

Means of capture.—Nets of about 30 yards long and 18 feet deep, made of fine twine and having a small mesh. One end is held by a person on shore, while another in a boat has the other end. The net is thus dragged at the surface of the water parallel with the shore, or encircling a portion of a bay or of the shore. At Portsmouth Yarrell describes another mode of capture. A concave circular net is suspended from an iron ring of four feet in diameter, kept horizontal by a three-slip bridle. The net is lowered steadily in eight feet of water, among the timber floating on the side of the harbour nearest the dockyard. Pounded crabs sprinkled over the net is the attraction; and the net is occasionally raised to the surface. A nearly similar plan is employed, according to Buckland, at Lymington in Hampshire, where a man dips a circular net suspended from a pole into the water; he then baits it, and finally raises it by using the side of the boat as the lever for the pole. They readily take a bait when assembled at the end of piers.

Bait.—Ogilby states that at Portrush it is only caught by fishing with a small hook, baited with a piece of the flesh of the *Galeus canis*, that of every other dog-fish being refused (Zool. 1876, p. 4754). In Cornwall it is found to take a bait readily: in fact along the south coast they are taken by anglers from projecting points in several localities, and observed by Yarrell to be so even when they are heaviest with roe.

Breeding.—July. "June, July, and early in August" (R. Couch). In spring they approach the shore at Dingle Harbour, to spawn (Andrew's).

Uses.—Said to be a good bait, especially for haddocks.

As food.—Some have deemed it a well-flavoured fish, but rather dry and inferior to the true smelt, and best when in full roe. Others consider them worthless as food and full of bones.

For cooking.—They should not be disembowelled, as the liver and roe improve their taste.

Habitat.—This species extends from the north-east coast of Scotland; very sparingly along the east shores of Great Britain, but abundant on the south. It is also found on the Atlantic coasts of France and the Iberian peninsula, and has been reported from the Mediterranean.

This fish has been recorded at Aberdeen (Sim); St. Andrew's, where it is rare, but one local specimen exists in the museum (McIntosh); in the Firth of Forth it is sometimes washed ashore after easterly winds (Neill), but is usually rare (Parnell). It is recorded from Bridlington Bay, Yorkshire, where it is not uncommon (Hardw. Sc. Gossip, p. 254): this remark of Meynell appears to be doubted in the Fauna of Yorkshire, p. 113. In the Norfolk estuary it is said to be frequent during the summer months (Lowe), and found at Lowestoft (J. Gurney). Montagu observes that the atherine is as plentiful on some parts of the southern coast of England as the smelt is on the eastern coast, and each seems to have its limits. In Kent the atherine appears to be unknown, but is extremely plentiful in Hampshire, especially about Southampton. On the south coast of Devonshire it is caught in great abundance in the creeks and estuaries, but never in rivers above the flow of the tide. It appears to continue near the shore through the months from autumn to spring. It is found off Dungeness in Kent (Yarrell), along the coast of Sussex (Jenyns); throughout the year, except during frosts, at Southampton (Pennant); at Weymouth it is common in the harbour (P. Gosse); also along the Devonshire coast (Donovan); Exmouth (Ross); and a frequent visitor during autumn to Cornwall, where it arrives in large shoals and is considered to be excellent eating.

Ireland.—Found in certain localities from the coast of Down, where it is plentiful, southwards to that of Cork, being not uncommon at Wexford (Walker), and Youghal (Ball); and the *smelt* alluded to by Rutty as existing in the county of Dublin, and Smith in the county of Cork, are suggested by Thompson to be this species. It is mostly brought to market at Belfast from December to April, both months inclusive, but has been observed as early as September. In autumn it is very common in the harbour at Portrush, county of Antrim (Ogilby, Zool. 1876, p. 4754). Dingle Harbour abundant (Andrews). In Belfast Bay one was taken in January, 1851, from the stomach of a red-breasted merganser, *Mergus serrator*, shot there (Walker). Said to attain a larger size in Ireland than in England. In Strangford Lough its average length is recorded at $6\frac{1}{4}$, a few 7, and one $7\frac{3}{4}$ inches long.

2. Atherina Boyeri, Plate LXV, fig. 2.

Hepsetus, Rondel. i, lib. vii, c. 10, p. 215; Gesner, Aquat. iv, p. 71. *Lavaronus*, Gesner, l. c. p. 73; Aldrov. ii, c. 37, p. 218; Jonst. Pisc. i, art. 19, p. 52.

Anguela, Willugh. iv, c. 2, p. 209; Ray, Syn. p. 79.

Atherina hepsetus, var. 3, De la Roche, An. Mus. xiii, p. 357.

Atherina Boyeri, Risso, Ich. Nice, p. 333, pl. x, f. 38, and Eur. Mérid. iii, p. 470; Cuv. and Val. x, p. 432, pl. cccciii (*semi-adult*); Bonap. Faun. Ital. Pesc.; Swainson, Fishes, ii, p. 243; Guichen. Explor. Algér. Poiss. p. 66; Günther, Catal. iii, p. 395; Canestr. Fauna Ital. p. 116; Moreau, Poiss. France, iii, p. 205.

Boiers atherine, Couch, Fish. Brit. Isles, iii, p. 4, pl. cxxi, f. 1.

B. vi, D. 7-8/$\frac{1}{11-12}$, P. 14-15, V. 1/5, A. $\frac{1}{12-14}$, C. 17, L. l. 50-57, L. tr. 4/6. Vert. 44-46.

Length of head $4\frac{1}{2}$ to $5\frac{1}{3}$, of caudal fin $5\frac{1}{2}$ to $6\frac{1}{2}$, height of body $5\frac{1}{2}$ to 6 in the total length. *Eye*—$2\frac{1}{2}$ diameters in the length of the head, 2/3 of a diameter from the end of the snout, and 1 diameter apart. Cleft of mouth very oblique; the posterior extremity of the maxilla reaches to beneath the front edge of the eye. *Teeth*—present in jaws, vomer, palatine bones, and on the tongue. *Fins*—the first dorsal fin commences above the middle of the ventral. *Colours*—similar to the last species, the lateral band occupies the lower half of the fourth row of scales, all the fifth, and the upper half of the sixth row.

The foregoing brief descriptions are from the specimens in the British Museum, which appear to differ from *A. presbyter* in the size of the eye and number of vertebræ, provided such characters are constant. But Jenyns found the eye in *A. presbyter* as large as any yet observed in *A. Boyeri*. The difference in a few fin rays more or less can hardly be a criterion as to species in individuals of this genus, wherein such great variations are shown as I have observed in the British form (page 225). Professor Steindachner (Sitz. Ak. Wiss. Wien, 1868, lvii, pp. 676-680) considers *A. Boyeri* to be the young of *A. presbyter*.

Habits.—Couch observes that in October, 1846, in the midst of turbulent weather, there was discovered in the harbour of Polperro, Cornwall, a large number of small fishes, which only remained a week, and when present manifested actions unlike those of known species. They swam near the surface, not more than three or four, within a foot or two of each other, but the whole scattered loosely over the water to the number of several thousands. They were so vigilant that it became scarcely possible to approach them, as at the sight of a moving object they were, in an instant, off in another direction.

Habitat.—According to Couch and Günther from the south coast of Great Britain, to and in the North Atlantic as far as Madeira. Also the shores of the Mediterranean, having been first described by Risso in his Ichthyology of Nice.

Couch's examples did not exceed 3 inches in length, and were considered by himself and Yarrell to belong to this species; but the specimens appear to have been lost, and it is doubtful if *A. presbyter* was not the form alluded to.

The examples figured, rather more than life size, is one of Lowe's specimens from Madeira.

Family, XXV—MUGILIDÆ, *Cuvier.*

Branchiostegals from five to six: pseudobranchiæ present. Gill-openings wide: gills four. Form of body oblong, compressed, while the head and anterior portion may be depressed. Eyes lateral, with or without adipose lids. Mouth narrow, or of moderate width. Opercles usually unarmed. Teeth very fine, sometimes absent. Two dorsal fins, separated by some interspace from each other, the first consisting of four stiff spines; anal slightly longer than the second dorsal; ventral abdominal, and suspended from an elongated shoulder bone, it consists of one spine and five rays. Scales cycloid, rarely ctenoid, extending on to the head. Lateral-line absent. Pyloric appendages generally few. Air-bladder large. Vertebræ 24 to 26.

In India and Burma I have observed that in such forms as *Mugil corsula*, *M. cascasia*, and *M. Hamiltonii*, which mostly or entirely reside in fresh water, the scales are strongly ctenoid, while the two last have merely two pyloric appendages.

Geographical distribution.—These cosmopolitan fishes are found in most temperate and tropical seas, where they frequent the shores, and ascend the larger rivers even into fresh water. Some forms appear to be entirely restricted to fresh water.

Genus I.—Mugil, *Artedi.*

Branchiostegals from four to six: pseudobranchiæ present. Eyes with or without adipose lids. Mouth more or less transverse, having a shallow cleft, and the anterior edge of the mandible sharp. Teeth, when present, minute. Pyloric appendages generally few (2-10). *Upper portion of the stomach very muscular: intestinal tract long.*

Fishes of this genus may be divided for convenience into (1) such as possess or (2) are deficient in adipose eye-lids. The second dorsal fin may commence opposite, anterior, or posterior to the origin of the anal; while an elongated axillary scale may be present or absent, and the soft dorsal and anal fins may be scaled or scaleless. The lips may be thin or thickened, and provided with papillæ, which would seem to be more prominent at some seasons than they are at others. Usually these fishes have eight or nine branched rays to the anal fin, the last, which is divided to its base, being considered as one. But in some species, as the Indian *M. parsia*, or the British *M. capito*, either number may be found.

Respecting the mullets which live in the British seas, some differences of opinion exist. Irrespective of *M. curtus*, Yarrell: Thompson and Couch merely recognized two, *Mugil capito*, a "thin-lipped" species, and *M. chelo*, a "thick-lipped." Dr. Günther has widely diverged from the opinions of his predecessors, and states that the following all belong to the British Fauna, *Mugil octo-radiatus*, Günther; *M. capito*, Cuvier; *M. auratus*, Risso; *M. septentrionalis*, Günther, while he discards *M. chelo* altogether. Couch observed that he was only acquainted with two, to which he restricted his history and description; so merely copied *M. auratus* and *M. octo-radiatus* from the "catalogue of fishes," and entirely omitted *M. septentrionalis*. As far as my experience goes, it agrees with Yarrell, Thompson, Couch, Steindachner, Moreau, and others; *M. octo-radiatus*, Günther, being simply a synonym for *M. capito* whenever the anal fin has eight instead of nine soft rays: and *M. septentrionalis*, Günther, being identical with *M. chelo;*

while the existence of *M. auratus* in the British seas, as asserted by Dr. Günther, may be due to some error, for Dr. Moreau, in his interesting work on the Fishes of France, remarks, "il a confondu cette espèce avec un autre, ainsi que le prouve la figure jointe au texte. M. Günther donne l'esquisse d'une tête, qui assurément n'a jamais appartenu à un Muge doré." (Vol. iii, p. 186.)

As regards the breeding of the British forms it has been observed by Mr. Dunn, that off Cornwall, mullets spawn twice a year, in May and in November, but it does not seem improbable that the two species, *M. capito* and *M. chelo*, do so at different seasons, the latter appearing to deposit its ova in May and June, as the young which I obtained in August are all of the thick lipped-form: whereas *M. capito* appears in shoals off Cornwall during the latter end of the year, and perhaps breeds in November.

Mullets have frequently been kept in large salt and even fresh water aquaria. In 1831, Mr. Arnold of Guernsey communicated to the Zoological Society of London some experiments which he had personally carried out on this subject, in a five-acre lake of varying depths, having a muddy, gravelly or rocky bottom, and which was principally filled with fresh water. Here for nine months in the year cattle came to drink, but in summer the water was too salt, due to a supply from the sea being received through a tunnel. Among the introduced fish were mullets, which it was remarked bred as freely as if they remained in the sea. M. Leon Vidal, in Bull. Soc. Zool. d'Acclimat. 1867, p. 190-200, observes upon how mullets may be semi-domesticated, and brought to a marketable size. In August, 1881, being at Devonport, I was shown a most beautiful piece of water, on the three sides of which trees came down to its edge; a small stream flowed in from the high lands above, while at its lower end a tunnel communicated with the backwater, and through which saline water obtained an entrance. A long weir prevented entrance of fish into, or exit from, this really beautiful lake. Here were many mullets which the owner had netted and introduced during the last few years, and they are, I am informed, of the thick-lipped species, *M. chelo*. On the other hand, Mr. W. Lloyd having received at Hamburgh a mullet (*M. capito ?*) from the Bay of Kiel in the Baltic, where the water contained only twelve per mil. of saline matter, transferred it to North Sea water, in which the salts were from thirty-six to thirty-eight per mil. The fish could not but float, it made ineffectual efforts to descend under and keep below the surface, and died in about three hours.

They are found to be hardy and long-lived in an aquarium, which has been attributed to their passing most of their time near the top of the tank, where the water is most aërated, while their vivacity likewise keeps it in motion.

These fish are very active, and as soon as a shoal is enclosed by a net they at first lose all order, but this soon becomes re-established, and a leader seeks for a hole or way beneath the obstruction, or failing this they essay to spring over. At Mevagissey a shoal entered the harbour, and having been perceived, the entrance was at once barred by nets. The fish first tried to jump over, but a net was raised so as to bar that route. The water was very clear, and the fish were seen to swim round and round, to try to find an exit. Next they attempted to get under the foot rope: at last one made a push, but became meshed. When this was done, another came and laid beside it, and nothing could drive it away. In short, all escaped but these two. Carew had a pond of salt water in Cornwall, in which mullets were kept, and having been accustomed to feed them at a certain place every evening, they became so tame that a knocking like that of chopping caused them to assemble.

There are two points of great interest in the internal anatomy of these fishes, which must not be passed over in silence: the first being how they feed, and the second the conformation of their stomachs. In an aquarium it is most interesting to observe them suck in the sand, the coarser portion of which they almost immediately afterwards expel from their mouths. A sifting or filtering apparatus exists in the pharynx, which precludes large and hard substances from passing into the stomach, or sand from obtaining access to the gills.

In these fishes the æsophagus passes into the cardiac portion of the stomach,

which forms a blind sac; while the pyloric portion is conical externally, somewhat resembling a bird's gizzard, but which, when cut into, is found to consist of thick muscular walls formed of circular fibres, leaving a small cavity internally, lined with a thick and horny epithelium. The pyloric opening is protected by a valve, and here are seen the orifices of the cœcal appendages which usually encircle the commencement of the small intestines.

Mullets are much esteemed as food, but perhaps more so on the Continent than they are in Great Britain, while such as have been taken in clear streams are much better flavoured than those captured in the ocean; any that have been resident in stagnant pools where reeds abound, or where the bottom is foul and oozy, are generally to be avoided. They ought to be cooked the same day they are captured. Large numbers are exported to France from Great Britain.

Before cooking they must first be very carefully eviscerated and cleansed, as they are not always very particular as to the food they swallow. In this country they are commonly boiled, and melted butter with anchovy or caper sauce may be sent to table with them.

In Italy the hard roe of mullets is converted into cakes termed *botarge* and *botargo*, which are prepared by washing, sprinkling with salt, and pressing between two boards. This may be smoke or sun dried, and is considered a good appetizer to promote thirst. But in Ceylon and on the Malabar coast of India the same article is somewhat similarly treated, and considered excellent for curries.

The modes of capture adopted for taking mullets around these islands, will be found detailed under the respective species (pp. 231, 234). Abroad further devices are employed. Thus at Naples, when these fishes are surrounded by a net, the fishermen first set to work to terrify them, which is accomplished by making a great disturbance on the surface of the water: or else they place a raft composed of reeds round the outside of the nets, so that the mullets which spring over are captured by persons stationed there for that purpose. In a nearly similar manner some of the fishermen on our own coast scatter straw on the water on the inner side of the net: on to this the fish throw themselves, but only to fall into the inclosure again, while it is believed that having once failed they give up further efforts at escape. Pliny observes mullets are stupid, asserting, probably erroneously, that one of their traits is to thrust their heads into the sand, in order to escape observation: and Badham suggests that in Shakespeare's day there was probably an adage "Dull as a mullet," the latter word having come down to us as a "mallet" (Henry IV, part 2), which is probably an incorrect reading.

1. **Mugil capito,** Plate XLVI.

Mugil, Artedi, Genera, p. 32 and Species, p. 71; Gronov. Zooph. no. 397. *Meuille blanc*, Duhamel, Pêches, ii, sect. 6, p. 147, pl. xi, t. 3. *Mullet*, Pennant, Brit. Zool. (Ed. 1) iii, p. 329, pl. lxvi (Ed. 2) iii, p. 436, pl. lxxvii.

Mugil capito, Cuv. Règ. Anim.; Bonap. Fauna Ital. Pesc. p. 31, t. f. 1; Cuv. and Val. xi, p. 36, pl. cccviii; Jenyns' Manual, p. 375; Parnell, Wern. Mem. vii, p. 225, t. xxvii, and Fishes Firth of Forth, p. 65; Yarrell, Brit. Fishes (Ed. 1) i, p. 200, c. fig. (Ed. 2) i, p. 234 (Ed. 3) ii, p. 175; Nilss. Skand. Fauna, iv, p. 176; Thompson, Nat. Hist. Ireland, iv, p. 106; Guichen. Explor. Algér. Poiss. p. 67; White, Catal. p. 27; Günther, Catal. iii, p. 439; Blanchard, Poiss. eaux Douces France, 1866, p. 248; Steind. Ich. Span. u. Port. 1868, p. 14; McIntosh, Fish. St. Andrew's, p. 176; Collett, Christ. Vid. Selsk. Förh. 1879, p. 60; Giglioli, Pesc. Ital. p. 33; Moreau, Poiss. France, iii, p. 188.

Mugil cephalus, var. A. Risso, Ich. Nice. p. 344.

Mugil ramada, Risso, Eur. Mérid. iii, p. 390.

Mugil Britannicus, Hancock, London Quart. Journ. Sc. 1830, p. 129.

Mugil octo-radiatus, Günther, Catal. iii, p. 457.

Gray mullet, Couch, Fish. Brit. Isles, iii, p. 6, pl.cxxii.

B. vi, D. $4/\frac{1}{8-9}$, P. 17, V. 1/5, A. $\frac{3}{8-9}$, C. 17, L. l. 42-46, L. tr. 14, Cœc. pyl. 6-8.

Length of head 5 to $5\frac{1}{2}$, of caudal fin $5\frac{1}{4}$ to $5\frac{1}{2}$, height of body $4\frac{1}{2}$ to $5\frac{1}{3}$ in the total length. *Eye*—without adipose lids, the diameter of each $4\frac{1}{2}$ to $4\frac{3}{4}$ in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 2 to $2\frac{1}{4}$ apart. Interorbital space nearly flat: snout broad and depressed: upper lip not thickened. Angles made by the anterior edges of the mandibles a little obtuse: width of the gape of the mouth nearly equal to three times the extent of the cleft: mandibles broad: the end of the maxilla visible behind and below the angle of the mouth. Preorbital very finely serrated at its external edge. Nostrils nearer the eye than the end of the snout. The free space on the chin is narrow, and reaches to nearly opposite the hind edge of the preopercle. *Teeth*—fine labial ones in upper jaw. *Fins*—first dorsal commences either nearer to the snout or midway between it and the base of the caudal fin; its spines are of moderate strength, the two first being of about equal heigth, and not quite equalling half the length of the head, the interspace between the two fins being equal to $1\frac{2}{3}$ or twice the length of the base of the first dorsal: second dorsal anteriorly slightly higher than the first. Pectoral inserted some little distance above the centre of the depth of the body, and its length equalling that of the head, excluding the snout. Anal commences somewhat in advance of the second dorsal. Ventral inserted midway between the base of the pectoral and that of the first dorsal. Caudal deeply forked, its lobes nearly equalling the length of the head. *Scales*—24 or 25 between the snout and the spinous dorsal: about 6 in the interspace between the dorsal fins. No large pointed axillary scale: the pectoral fin reaches to about the 11th or 12th scale of the lateral-line: the first dorsal commences above the 13th or 14th scale of the lateral-line: and the second above the 26th. No scales on the second dorsal or anal fins: a long angular one at the base of the ventral. *Colours*—silvery becoming lighter below: six to eight dark blueish bands along the rows of scales of the back and sides: head shot with golden: fins grayish.

In 1861 *Mugil octo-radiatus*, Günther, was separated from *M. capito*, principally due to its possessing only eight instead of nine soft rays in the anal fin; a very common variation, not only among the British but also continental specimens. October 20th, 1880, a number arrived from Brixham, out of them I selected nine, and found one had D. 4/8, A. 3/9, another, D. 4/8, A. 3/8, while not the slightest external difference could otherwise be detected between the two. February 2nd, 1881, a number came from St. Ives, where shoals had been netted the previous day, the longest were 13 inches. The rays agreed with *M. capito*, the snout with *octo-radiatus*.

Names.—*Gray mullet*, *thin-lipped mullet*. *Mowel* (Halliwell). *Le muge capiton*, French.

Habits.—Couch observed that it never goes far from land, but delights in shallow water during the warm weather, snatching at any oily substance that may chance to be floating about. It ventures some distance up rivers, returning with the tide, and frequently enters by the flood-gates into a salt water mill-pool at Looe, which contains about twenty acres. It selects soft and fat food, or such as has commenced to decompose.

In autumn and winter these fish are very plentiful and gregarious. They are more active than *Mugil chelo*, and when enclosed in a seine they jump much higher. During October and November, 1880, I examined many obtained from Brixham and the coasts of Cornwall, and all belonged to *M. capito* as described.

Means of capture.—Netting, and rarely by hooks, but it is as active at escape as the *M. chelo*. It sucks at its food, and will occasionally take a rag-worm or artificial fly. In the Stour it is observed that slimy stuff, which after a drought rises most freely from the bed of the river, will stick to the hook, and no other bait equals it. Couch says that it is most readily taken with bait formed of the fat entrails of a fish, or cabbage boiled in broth. It is angled for as the tide is coming in, for on the ebb it returns to salt water.

Breeding.—As before observed (p. 229), I suppose this is the form which has been observed to breed off Cornwall in the winter months.

As food.—They are moderately esteemed in this country.

Habitat.—This species would seem to be very rare on the coast of Norway, but was possibly the form captured off Denmark in the Cattegat, October 8th, 1852. Occasionally taken on the shores of the German Ocean, becomes more numerous along the south and south-west coasts of Great Britain, and the Cape of Good Hope. It extends through the Mediterranean to the fresh water lakes of Tunis, and in the Nile certainly so far as Cairo.

In the British Isles some confusion respecting its distribution exists. Many of the recorded Scotch examples may belong to *M. chelo*, but the British Museum has received specimens from the Firth of Forth. It would seem to be occasionally taken off the Yorkshire coast (Meynell, 1844), and is said to be resident and local, but its distribution requires investigation (Yorkshire Fauna, 1881). I have obtained many examples, but all from the south and south-west coast, captured between the months of September and March inclusive. It is said to occur constantly on the Kentish and Essex shores (Yarrell).

In Ireland this species was not found by Thompson, who however only had the opportunity of examining mullets from the east coast. In the Cork Fauna (1845), Dr. Harvey gives *M. capito* as certainly present, and *M. chelo* with doubt.

The example figured is $7\frac{1}{2}$ inches in length, and came from Brixham. This fish exceeds 3 feet in length.

2. **Mugil chelo**, Plate LXVII.

Chelon, Rondel. Pisc. i, lib. ix, c. 5, p. 266; Gesner, Aquat. iv, p. 552; Willughby, iv, c. 4; Ray, Syn. p. 84. *Mulet chaluc*, Duham. Pêches, iii, sect. vi, c. 2, p. 147.

Mugil cephalus, Donovan, Brit. Fish. i, pl. xv; Turton, Brit. Faun. p. 106; Fleming, Brit. An. p. 217; Neill, Wern. Mem. i, p. 544; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409.

Mugil chelo, Cuv. Règne Anim.; Bonap. Faun. Ital. Pesc. vi, H; Cuv. and Val. xi, p. 50, pl. xxxix; Yarrell, Brit. Fishes (Ed. 1), i, p. 207, c. fig. (Ed. 2) i, p. 241 (Ed. 3) ii, p. 182; Jenyns, Man. p. 375; Johnston, Berwick. Nat. Field Club, 1838, i, p. 171; Thompson, Proc. Zool. Soc. 1837, p. 57, and Nat. Hist. Ireland, iv, p. 100; Parnell, Wern. Mem. vii, p. 228, t. xxviii, and Fishes Firth of Forth, p. 68, pl. xxviii; Guichen. Explor. Algér. Poissons, p. 67; Nordm. in Démid. Voy. Russ. Mérid. p. 395; White, Catal. p. 27; Günther, Catal. iii, p. 454; Schlegel, Dieren Neder. p. 26, t. v, f. 1; Steind. Ich. Span. u. Port. 1868, p. 17; Nilss. Skand. Faun. iv, p. 177; Collett, Norges Fiske, p. 88, and Christ. Vid. Selsk. Forh. 1879, p. 60; Giglioli, Pesc. Ital. p. 33; Moreau, Poiss. France, iii, p. 195; Winther, Ich. Dan. Mar. p. 24.

Mugil provensalis, Risso, Ich. Nice, p. 346.

Mugil labrosus, Risso, Eur. Mérid. iii, p. 389.

Mugil cephalus, var. B., De la Roche, Ann. Mus. xiii, p. 358, t. xxi, f. 7; Schagerstr. Vet. Akad. Handl. 1829, p. 90, t. iii, f. 1.

Mugil capito, Nilss. Prod. p. 69.

Mugil septentrionalis, Günther, Catal. iii, p. 455.

Lesser grey mullet, Couch, Fish. Brit. Isles, iii, p. 15, pl. cxxiii.

(*Varieties.*)

Mugil curtus, Yarrell, Brit. Fishes (Ed. 1), i, p. 210, c. fig. (Ed. 2) i, p. 245 (Ed. 3), ii, p. 186; Cuv. and Val. xi, p. 70, pl. cccxi; Jenyns, p. 376; White, Catal. p. 28; Günther, Catal. iii, p. 439.

B. vi, D. $4/\frac{1}{8}$, P. 17, V. 1/5, A. $\frac{3}{9-10}$, C. 15, L. l. 43-45, L. tr. 15-16, Cœc. pyl. 5-7, Vert. 11/13.

Length of head $4\frac{3}{4}$ to 5, of caudal fin $5\frac{1}{2}$, height of body $4\frac{1}{2}$ to 5 times in the total length.* *Eyes*—without adipose lids, the diameter of each $4\frac{1}{2}$ in the length

* But this last proportion, as remarked by Thompson, is liable to great fluctuations; taking five examples which were all equally firm and solid, and each of the same length—two feet—he found they weighed $5\frac{1}{2}$, 6, $6\frac{1}{2}$, 7, and 8 lb. respectively.

of the head, from 1 to $1\frac{1}{4}$ diameters from the end of the snout, and $2\frac{1}{2}$ apart. Interorbital space slightly convex. Snout obtuse: upper lip rather thick, with two or three rows of papillæ on its lowest portion, the size of which much decreases in many examples after they have been some time in spirit; while in others there are several but much smaller rows perhaps due to season. Angles made by the anterior edges of mandibles obtuse, the extent of the gape of the mouth being about three times as wide as the depth of its cleft: mandibles very broad: the end of the maxilla visible behind and below the angle of the mouth. Preorbital obtusely truncated, posteriorly coming to a point: its lower edge, which is somewhat rounded, being finely serrated. Nostrils nearly close together, and somewhat nearer to the orbit than to the end of the snout. A narrow strip of the chin is uncovered. *Teeth*—fine labial ones in the upper lip. *Fins*—the dorsal commences somewhat nearer the caudal fin, or midway between it and the end of the snout: spines stout, the two first of the same height, and equalling that of the postorbital length of the head. The interspace between the two dorsal fins equal to or slightly exceeding that of the base of the first dorsal. Second dorsal anteriorly slightly higher than the first. Pectoral inserted somewhat above the centre of the depth of the body, and its length equalling that of the head excluding the snout. Ventral inserted midway between the origins of the pectoral and first dorsal fin. Anal below the second dorsal and rather higher than it. Caudal forked, the length of each lobe being about equal, or rather less than that of the head. *Scales*—about 26 between the snout and the base of the first dorsal fin. The second dorsal commences above the twenty-ninth scale of the lateral-line: the pectoral reaches the tenth or twelfth, and has no elongated angular scale at its angle; while such is present at the base of the ventral and first dorsal. A few scales on upper part of the preorbital and the anterior edge and base of soft dorsal and anal fins. *Intestines*—five rather short cœcal appendages. *Colours*—Gray shot with bronze about the head, cheeks golden, sides silvery dashed with gold; a dark line along each row of scales along the back and sides.

In 1861 *Mugil septentrionalis*, Günther, was separated from *M. chelo*, for which subdivision the following reasons were principally adduced. In *M. septentrionalis*, pyloric cœca five instead of seven (as in *M. chelo*). Upper lip with two rows of papillæ instead of three; preorbital with its anterior angle obtuse and its posterior pointed, instead of its posterior extremity being rounded, its anterior angle not much wider than its posterior, and possessing a longitudinal ridge; twenty-six scales between the snout and base of first dorsal fin, instead of twenty-eight; ten rows to the end of the pectoral instead of thirteen; origin of spinous dorsal midway between end of snout and base of caudal fin, instead of being nearer the caudal than to the snout. Professor Collett, l. c., and Steindachner (Sitz. Ak. Wiss. Wien. 1868, lvii, pl. 680-685), have been unable to appreciate the difference between the two forms, while Dr. Moreau has remarked that this so-called new species is precisely the form which is figured in Bonaparte's Fauna Italica as *Mugil chelo*.

Donovan's *M. cephalus* would seem from the length of the interspace between its two dorsal fins, and the position of its anal as regards the second dorsal, to belong to this species. It appears to me that Neill and Templeton have so regarded it, which accounts for the former finding it occasionally in the Moray Firth, where Parnell remarked that it was a singular fact that not a single specimen had fallen under his notice. While this species is the common Irish one, and was most probably the form which Templeton alluded to.

Varieties.—*Mugil curtus*, Yarrell, would seem to be a young example of this species, in which the body was somewhat unnaturally shortened. Mullets are not unfrequently deformed. Professor Giglioli last year obtained in Italy "a large *M. cephalus* nearly as broad as long."

Names.—*Lesser gray mullet, thick-lipped mullet. Le muge a grosses lèvres*, French. *De harder*, Dutch.

Habits.—Very gregarious, frequenting harbours, mouths of rivers so far as the tide extends, inlets of the sea, and but rarely enters deep waters. It seems to delight in the most oozy parts of bays, and where the grass-wrack, *Zostera marina*,

is abundant; and while searching for food it makes excavations, known to fishermen as mullet holes. Along the south coast in June, July, and August, it goes into harbours for food, and during these months in 1880 among those I saw all were of the thick-lipped species, *Mugil chelo*, of which I obtained examples at Penzance, Plymouth, and Dawlish, but did not see a single one of the thin-lipped *M. capito*. Thompson observes that in Ireland it is sought for from the middle of March until the beginning of October. During the fine weather of summer, and especially at high water, it frequently ascends to the surface, either for sport or searching for floating food; while at night time its activity often increases, and numbers of them leaping about will make the water seem quite alive. In a very hot season, Yarrell observes, mullets in the Avon were observed to ascend to nearly twenty miles, and far beyond the flow of even spring tides.

At Belfast, notwithstanding the great increase of shipping of late years, it is as plentiful in the bay as it ever was known to be by the few persons engaged in its capture (Thompson, 1838).

During the first two weeks in April, 1847, a large shoal of mullet appeared at Coldingham, near Berwick, a fish very rare in that locality. Having been seen daily going with the tide, a net was placed across the entrance to the harbour which was crowded with them. Numbers were taken, the rest at once went away. A somewhat similar occurrence was said to have occurred ten years previously a little further to the west. Mullet sometimes live some hours after removal from the water. It is very destructive to molluscs and minute crustacea; it also eats larvæ and ova. It lives on soft food and is rarely captured except by means of drag nets or seines. Thompson observed, respecting the contents of the stomachs of some of these fish examined at various seasons, that from the minute size of the contained objects it occasions many hundredfold greater destruction of animal life than he had ever witnessed on a similar inspection of the food of any bird or fish. He obtained from them examples of *Mytilus edulis*, *Modiola papuana*, *Kellia rubra*, *Skenea depressa*, *Littorina retusa*, *Rissoa labiosa*, and *R. parva*, *Serpulæ*, and *Miliolæ*. There were also minute crustacea, and fragments of *Zostera marina* and *Confervæ*. Dr. Drummond found *Algæ* in the stomachs of some, as *Enteromorpha compressa*. A correspondent of Thompson's informed him that about the middle of July, 1843, he saw about forty mullets enjoying themselves by drinking in from a stream of fresh water as it joined the sea-water of Belfast Bay. They sometimes are observed to frequent localities where drains open, evidently for the purpose of feeding. In an aquarium they will feed on large lob-worms or chopped up mussels.

Means of capture.—Trammel or set nets, but at low water the draft net is used, while at Belfast cow-dung is spread on the water as an attraction, and which they greedily devour. Sometimes in small streams, as near Southampton, shoals ascend and may be hooked with an artificial fly. In the Field for July, 1881, it is observed that Mr. H. R. White has not omitted taking gray mullet for some years past with the soft inner portion of the stump of boiled cabbage, which, when he sees these fish priming on the surface of the water, he contrives, with the aid of his boat, to trail through the school, allowing the bait not to sink more than two feet. Fine and strong tackle is necessary, with plenty of running line—as some of their dashes are of so impetuous a character that the tackle would go upon any determined attempt to restrain them. Others who have tried it have not been equally successful. The milt of a salt herring has also been recommended as a bait. They are a very sporting fish, and fight hard when hooked, making repeated leaps out of the water to release themselves.

In Ireland, Thompson observed that these fishes are guided by the weather, which must be moderate, they being taken at night in the largest numbers, when they cannot so well avoid the fatal net. In clear moonlight and by day fish of every size often clear the net sometimes springing five and six feet over it, and when one has set the example nearly all are sure to follow. He observed that an acquaintance out eel-spearing once struck and secured with his spear a mullet of 5 lb. weight as it was swimming on the surface. Dr. Ball likewise remarked that at Kingstown a dexterous individual kills many with a light spear. A correspondent of Land

and Water (Sept. 25th, 1880), writing from Margate, stated: There is an Italian gentleman here who fishes for gray mullet and bass every day under the jetty with a harpoon, something like an eel spear attached to a line. The fish come to devour the mussels on the piles of the jetty, and he is very dexterous in spearing them. Risso remarked on these fishes being attracted by a light and then speared.

Breeding.—Young mullets are first seen off Mevagissey late in July and generally near the surface. In August this year (1881), when at that town, Mr. Dunn pointed me out a school of young mullets (each of which measured about three-quarters of an inch in length) present in the harbour, upwards of a dozen of which were secured by means of a hand net. While swimming they appeared to have a white spot on the back, which disappeared on their being removed from the water. These belonged to the thick-lipped species.

Thompson, in Ireland, did not obtain any in spawn from March until September.

As food.—Esteemed for the table. The county of Sussex is celebrated in a gastronomical point of view for six things—a Chichester lobster, a Selsey cockle, an Arundel mullet, a Pulborough eel, an Amberley trout, and a Rye herring; the mullet referred to being this species according to Yarrell.

Habitat.—Coasts of Scandinavia, the German Ocean and Atlantic coast of Europe to Madeira, and also the Mediterranean.

In the Orkneys and Zetland the thick-lipped gray mullet is tolerably frequent from June to September (W. Baikie), and is the common species on the eastern shores of Scotland, where we believe *M. capito* is not known at all, or is at least far from common (Mag. Zool. and Bot. i, p. 390); it is common on the west coast of Scotland, and in some seasons numbers are taken off Dunbar (Parnell). It is found at Aberdeen (Sim), and has been noticed off Berwick (Johnston). Occasionally taken on the Yorkshire coast (Meynell, 1844); Mr. Barron found it to be the most plentiful of the two species at Portsmouth. I found it common during the end of July and August, 1881, at Dawlish in Devonshire, Plymouth and Penzance being the only species I could detect along the coast. Parnell also observed it to be excessively common on the Devonshire coast in September and October.

In Ireland it frequents the east coast from north to south, but whether or not it is the mullet found around this island I have not had the means of judging (Thompson); it also frequents the south coast of Ireland.

The example figured is 12 inches in length, but it attains to upwards of 3 feet, and one is recorded from Ireland weighing $14\frac{3}{4}$ lb.

Eleventh group—Acanthopterygii gasterosteiformes.

Mouth small: anterior. Spinous dorsal fin, when present, composed of isolated spines. Pubic bone attached to the humeral arch, and the ventral fins, if present, abdominal.

Family, XXVI—GASTEROSTEIDÆ.

Branchiostegals three: pseudobranchiæ present. Body elongated and compressed. Eyes lateral. Cleft of mouth oblique. Villiform teeth in the jaws. Opercular bones unarmed. The first dorsal fin composed of isolated spines. Ventral fins, when present, abdominal and articulated with the pubic bone, each consists of one spine and one soft ray. Scales absent, but sides of the body more or less cuirassed with bony scutes. Air-bladder present.

Genus I.—Gasterosteus, *Artedi.*

Centriscus, Klein; *Spinachia*, Fleming; *Leiurus* and *Polyacanthus*, Swainson; *Apeltes* and *Pygosteus*, Brevoort; *Gasterostea* and *Gastræa*, Sauvage.

Definition as given to the Family.

Fleming made *Gasterosteus spinachia* the type of his genus *Spinachia*, Swainson of *Polyacanthus*, and Sauvage of *Gastræa;* while *G. pungitius* forms the type of genus *Leiurus*, Swainson, *Pygosteus*, Brevoort, and *Gasterostea*, Sauvage.

Its name is derived from the words γαστὴρ, "the belly," and ὀστέα, "a bone," which has reference to the expansion of the pubic bone on the lower surface and to which the ventral fins are attached.

Geographical distribution.—Arctic and temperate regions of both hemispheres.

Sticklebacks are among the smallest forms of our fresh water fishes: and Buckland tells a tale of how one was served out with the afternoon milk at the door of a house in London. The only excuse the vendor had, was to beg pardon for not having strained the *water*. These fish abound in some of our reservoirs. The construction of nests for the reception of their ova appears to be a generic feature among them, pertaining equally to the marine and fresh water forms.

These fishes are subject not only to great variations in colour but likewise in structure, either of the plates on the sides or the spines of the fins, and these variations are more frequent in some localities than they are in others. If we investigate the number of species residing in these islands we find them variously stated by the different British ichthyological authors. Some can only perceive three species, two of which are fresh water forms, and these they believe to be subject to many variations in structure. Others would limit nature to one model, and all which fail to exactly agree with what they consider to be the type are by them referred to another species. While a third class of naturalists have gone still further and what are believed varieties by some, or distinct species by others, they would erect into types of genera or sub-genera. It will not, therefore, be a

waste of space to follow out the views of the various British and of some French ichthyologists respecting the fresh water forms of *Gasterosteus*, as the marine *G. spinachia*, looked on as a distinct genus by some, is not subject to the variations perceived in such sticklebacks as reside entirely or mostly in brackish or inland waters. Pennant, 1776, Shaw, 1803, Turton, 1807, Donovan, 1808, and Fleming in 1828, merely recognized two fresh water species, the three-spined and the ten-spined. In 1829 the fourth volume of Cuv. and Val. Histoire Naturelle des Poissons, was published, in this many forms heretofore looked upon as varieties were considered to be species. Yarrell's British Fishes, published in 1836, contains:—1. *G. trachurus*, Cuv. and Val. 2. *G. semiarmatus*, Cuv. and Val. 3. *G. leiurus*, Cuv. and Val. 4. *G. brachycentrus*, Cuv. and Val.; and 5. *G. spinulosus*, Jenyns and Yarrell; also 6. *G. pungitius*, Linnæus. Jenyns, 1835, restricted these forms to three:—1. *G. aculeatus*, including *trachurus*, *semiarmatus*, *leiurus*, and *brachycentrus*. 2. *G. spinulosus*, and 3. *G. pungitius*. Parnell, 1838, gave 1. *G. leiurus*, 2. *G. semiarmatus*, 3. *G. trachurus*, 4. *G. spinulosus*, and 5. *G. pungitius*. Thompson in the Annals and Magazine of Natural History, 1841, and Natural History of Ireland, 1856, restricts these numbers to 1. *G. aculeatus*, and 2. *G. pungitius*. White, 1851, again simply enumerated 1. *G. aculeatus*, 2. *G. spinulosus*, and 3. *G. pungitius*. Günther, 1859, recognized 1. *G. aculeatus*, 2. *G. brachycentrus*, 3. *G. spinulosus*, 4. *G. pungitius*, while the latter author* in 1880 again reduced his British forms by omitting number 2. Canestrini (An. Soc. Nat. Mod. ii, 1867, p. 9) disputed the accuracy of the varieties of *G. aculeatus*, as found in Italy, being considered as species.

M. Blanchard in his elegant work on the Fishes of the Fresh Waters of France, 1866, describes eight sticklebacks irrespective of *G. pungitius* and allied forms, which latter he divides into five species. Dr. Sauvage, 1874, recognizes three or four more out of a recorded total of forty-five: while Dr. Günther subsequently remarks in 1880 that "about ten species are satisfactorily known," and Dr. Moreau in 1881 reverts to the original two forms as existing in the fresh waters of France, placing the others as varieties.

It appears remarkable how many species have been named of sticklebacks, outnumbering even those of the Salmonidæ of the fresh waters, and it becomes a first consideration whether any general principles are perceptible in the distribution of these species or varieties. It is in the ocean more than in fresh waters that we must seek the spiny-rayed fishes: and similarly it is on the sea-boards or skirts of the ocean that we must look for sticklebacks in which the armature of the side is most developed (as in the variety *trachurus*), while such as have the free portion of the tail unarmed are furthest inland or on elevated plateaus: while in the centre of Ireland I have captured examples of *G. pungitius* in which the armature had so decreased that the ventral spine was entirely absent. It has been pointed out (Phil. Mag. 1834, v, p. 299) that the variety on the continent with the shortest spine or the most defenceless form, comes from Tuscany, and is peculiar to still waters, where it would have the fewest enemies, and here it attains to a great size. Taking large numbers of Irish specimens I found considerable differences in the length of the ventral spines and pubic plates, conclusively showing that such characters afford no reliable data.†

Heckel and Kner, in their account of the Fishes of Austria, did not admit the foregoing to be more than varieties differentiated by the development of the lateral scutes or plates, which they found varied in number between three and twenty-eight.

It appears to me that our British Gasterostei consist of merely three species, which are subject to an almost endless variation in colour and form. They may be divided as follows:

1. *Gasterosteus aculeatus*, D. 3-4/10-12. Sides of the body with or destitute of vertical flat plates.
2. *Gasterosteus pungitius*, D. 8-10/9-10. Sides of the body smooth.
3. *Gasterosteus spinachia*, D. 15/6-7. Snout produced: body very elongate.

* Introduction to the Study of Fishes, p. 505.

† Linn. Soc. Journal, Zoology, vol. xiii, "On some Irish Gasterostei," by Francis Day.

1. Gasterosteus aculeatus, Plate LXVIII, fig. 1, 2, 3.

Pungitius piscis, Albert. Mag. Aldrov. v, cap. 36. *Pungitius Alberti*, Jonston, iii, cap. 3. *Pisciculus aculeatus*, Rondel. ii, p. 206; Gesner, fol. 100*a*; Willughby, p. 341, t. x, f. 1; Ray, p. 145; Rutty, co. Dublin, i, p. 368. *Gasterosteus*, no. 1, Artedi, Species, p. 96; Gronov. Zooph. no. 405. *The three-spined stickleback*, Lowe, Fauna Orcad. p. 216; Pennant, Brit. Zool. (Ed. 1776) iii, p. 261, pl. 1, and (Ed. 1812) iii, p. 383, pl. lxi.

Gasterosteus aculeatus, Linn. Syst. Nat. p. 489; Bloch, t. liii, f. 3; Bl. Schn. p. 122; Bonnat. Atl. Ich. p. 136, pl. lvii, f. 222; Donovan, Brit. Fish. i, pl. xi; Shaw, Zool. iv, p. 604, pl. lxxxvii; Turton, Brit. Fauna, p. 101; Flem. Brit. An. p. 219; Risso, Ich. Nice, p. 192, and Eur. Mérid. iii, p. 427; Fries och Ekstr. p. 17, t. iv, f. 1; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 409; Johnston, Berwick. Nat. Club, 1838, i, p. 170; Kröyer, Dan. Fiske, i, p. 169, c. fig.; Thompson, Ann. and Mag. Nat. Hist. 1841, vii, p. 95, and Nat. Hist. Ireland, iv, p. 82; Nilss. Skan. Fauna, Fiske, p. 103; Jenyns, Man. p. 348; White, Catal. Fish. p. 35; Gronov. ed. Gray, p. 167; Günther, Catal. Brit. Mus. i, p. 2; Schlegel, Dieren Neder. p. 52, pl. iv, f. 4; H. Malmgren, Wieg. Arch. 1864, p. 282; Steind. Sitz. Ak. Wiss. Wien, 1865, Nov. 3; Blanchard, Poiss. France, p. 214, c. fig.; Canestrini, An. Soc. Nat. Mod. ii, 1867, p. 9; Bonizzi, Arch. per la Zool. 1869, p. 156, tav. iii; Collett, Norges Fiske, p. 11; Sauvage, Revis. Epinoches, Nou. Arch. Mus. d'Hist. Nat. 1874, p. 9; Day, Journal Linn. Soc. Zool. 1876, p. 110; McIntosh, Fish. St. Andrew's, p. 171; Houghton, Brit. F. W. Fish. p. 11, c. fig.; Collett, Norges Fiske, p. 11; Winther, Ich. Dan. Mar. p. 4; Giglioli, Pesc. Ital. p. 18; Moreau, Poiss. France, iii, p. 163.

Leiurus aculeatus, Swainson, Fishes, ii, p. 242.

Three-spined stickleback, Couch, Fish. Brit. Isles, i, p. 167, pl. xxxvii, fig. 1.

Variety 1.* Gasterosteus trachurus, Plate LXVIII, fig. 1.

Gasterosteus trachurus, Cuv. and Val. iv, p. 481, pl. xcviii, f. 1; Yarrell, Ann. and Mag. iii, p. 522, f. 127*a*, and Brit. Fishes (Ed. 1) i, p. 76, c. fig. (Ed. 2) i, p. 90 (Ed. 3) ii, p. 75; Swainson, Fishes, ii, p. 242; Nilss. Skan. Fauna, Fiske, p. 103; Parnell, Fishes Firth of Forth, p. 33, pl. xxv, and Wern. Mem. vii, p. 193, l. xxv; McIntosh, Fish. North Uist, Proc. Roy. Soc. Edin. v, 1862-66, p. 614.

Gasterosteus aculeatus, Ekström, Fische Mörkö, p. 153.

Gasterosteus aculeatus, var. *pontica*, Nord. in Demid. Voy. Russ. Mérid, iii, p. 357.

Rough-tailed stickleback.

In this variety the vertical scaly plates, from thirty to forty in number, extend along each side, from the head to the base of the caudal fin, becoming keeled in the last part of their course. The example figured life size I captured in a tidal pool at St. Andrew's.

Variety 2. Gasterosteus semiloricatus.

Cuv. and Val. iv, p. 494; Thompson, An. and Mag. 1841, vii, p. 95; Blanchard, Poiss. Eaux Douces, France, p. 222, c. fig.; Sauvage, Epinoches, p. 15.

The bony plates along the side are said to be from 22 to 23, instead of 25 or 26, in number, anterior to the origin of the caudal keel (such as shown in my figure of the last variety), and also that the shoulder plate is larger than in *gymnurus*.

Variety 3. Gasterosteus semiarmatus, Plate LXVIII, fig. 2.

Cuv. and Val. iv, p. 493; Yarrell, Brit. Fish. (Ed. 1) i, p. 80, c. fig. (Ed. 2) i,

* There are several species described by continental authors which I consider merely varieties of *G. aculeatus* and *G. pungitius*, but which I have not deemed it necessary to enumerate in this place.

p. 94 (Ed. 3) ii, p. 82; Parnell, Fishes Firth of Forth, p. 30, pl. xxv, and Wern. Mem. vii, p. 192, pl. xxv; Blanchard, Poiss. Eaux Douces, France, p. 224, c. fig.; Sauvage, Epin. p. 15.

The half-armed stickleback.

In this variety the vertical scaly plates from ten to fifteen in number extend from the head along the side half way to the base of the caudal fin; the lateral-line may have a slightly raised keel near the tail. The example figured life size I captured, assisted by Mr. Lonie, in a rock pool at St. Andrew's, along with the first variety.

Variety 4. Gasterosteus gymnurus, Plate LXVIII, fig. 3.

Cuv. Règne Anim. *Gasterosteus leiurus*, Cuv. and Val. iv, p. 481, pl. xcviii, f. 4; Yarrell, Ann. and Mag. N. H. iii, p. 522, and British Fish. (Ed. 1) i, p. 81, c. fig.; (Ed. 2) i, p. 95 (Ed. 3) ii, p. 83; Parnell, Fish. Firth of Forth, p. 30, pl. xxv and Wern. Mem. vii, p. 190, pl. xxv; Nilss. Skan. Fauna, Fiske, p. 105; Coste, Mém. Sci. Sav. Etrang. x, 1848; Günther, Neckarfische, p. 29; Warrington An. and Mag. N. H. (2) 1855, xvi, p. 330; Blanchard, Poiss. France, p. 225, c. fig.; Steind. Sitz. Ak. Wiss. Wien, 1865, Nov. 3rd; Sauvage, Epin. p. 16.

Gasterosteus dimidiatus, Reinb. Kgl. D. Vid. Selsk. Nat. Mat. Afh. B. 7, p. 104, og. 193.

The quarter-armed or *smooth-tailed stickleback.*

In this variety the vertical scaly plates, from four to six in number, extend from the head as far as the end of the pectoral fin, and this is the most common inland form in Great Britain and Ireland. The example figured life size I took at Edgeworthstown along with examples of varieties *brachycentrus* and *spinulosus.*

Variety 5. Gasterosteus brachycentrus.

Cuv. and Val. iv, p. 499, pl. xcviii, f. 2; Thompson, Nat. Hist. Ireland, iv, pp. 82, 85, 88; Yarrell, Brit. Fishes (Ed. 1), i, p. 82, c. fig. (Ed. 2) i, p. 96 (Ed. 3) ii. p. 88; Nilss. Skan. Fauna, Fiske, p. 106; Heckel and Kner, Süssw. f. 17; Günther, Catal. i, p. 5; Steind. Catal. Pré. Poiss. Port. Suite, p. 1; Sauv. Epin. p. 23; Houghton, British Fresh-water Fishes, p. 14, c. fig.

Leiurus brachycentrus, Swainson, Fishes, ii, p. 242.

The short-spined stickleback.

In this variety the dorsal and ventral spines are very short, and the vertical scaly plates, from four to six in number, extend along the side from the head to the end of the pectoral fin.

I took two examples at Edgeworthstown among a number of the varieties *G. gymnurus* and *spinulosus.*

Variety 6. Gasterosteus spinulosus.

Jenyns, Manual, p. 350; Stark, Jamieson's Edin. Journ. 1830, p. 327; Yarrell, Brit. Fishes (Ed. 1) i, p. 83, c. fig. (Ed. 2) i, p. 97 (Ed. 3) ii, p. 89; Thompson, Nat. Hist. Ireland, iv, p. 88; Parnell, Fishes Firth of Forth, p. 36, t. xxv, and Wern. Mem. vii, p. 196, t. xxv; Nilss. Skan. Fauna, Fiske, p. 106; White, Catal. p. 36; Günther, Catal. i, p. 5; Sauvage, Epin. p. 25.

Leiurus spinulosus, Swainson, Fishes, ii, p. 242.

Four-spined stickleback.

The extra spine is very short and situated between the normal last but one, and last: none of the spines serrated: the pubic plate long and narrower than in *G. aculeatus* of a similar size. None of Jenyns's examples exceeded $1\frac{1}{4}$ inches in length, and, as he observes, "possibly a mere variety of the last species, which is said to have been numerous in the same pond." Thompson (Nat. Hist. Ireland, iv, p. 88) observes upon possessing from near Portarlington, Queen's County, a

four-spined stickleback, which he would not but look on otherwise than merely an accidental variety of *G. aculeatus*, Linn. It was among a parcel consisting of *G. gymnurus*, *G. branchycentrus*, and *G. pungitius*, taken in a pond and in some neighbouring drains. The ascending plate from the base of the ventrals he found to be subject to variety in form like other parts. While that the fish under consideration was *G. spinulosus* he did not think admitted of a doubt. Allman records the same (N. H. Ireland, iv, p. 89). Johnston (Berwick. Nat. Club, 1838, p. 171) likewise considered this form a mere variety. At Edgeworthstown I obtained this fish under the identical conditions as Thompson, and came to the same conclusions. It appeared as if a dorsal ray had taken on a spinous character, each having D. $3/\frac{1}{10}$, whereas the common type had D. $2/\frac{1}{11}$.

B. iii, D. 2-3(4)$\frac{1}{10\text{-}12}$, P. 10 (-12), V. 1/1, A. $\frac{1}{8\text{-}9}$, C. 12, Cœcal pyl. 1 (2), Vert. 15/16.

Length of head $3\frac{1}{2}$ to $4\frac{1}{4}$, of caudal fin $7\frac{1}{4}$ to 8, height of body $3\frac{1}{2}$ to 4 in the total length. *Eye*—diameter $3\frac{1}{2}$ to $3\frac{3}{4}$ in the length of the head, 1 to $1\frac{1}{2}$ diameters from the end of the snout, and 3/4 to 1 apart. Sides of the body compressed. Snout of moderate extent: the cleft of the mouth oblique, the lower jaw slightly in advance of the upper, the posterior extremity of the maxilla reaching to beneath the posterior nostril. Nostrils midway between the eye and the end of the snout. Opercles smooth: interorbitals wide. *Teeth*—fine, those in the upper jaw anteriorly in three rows, decreasing to one posteriorly: in the mandibles in four irregular rows anteriorly, decreasing in size posteriorly where they become a single row. None on the palate or tongue. *Fins*—the first dorsal consists of free spines from two to four in number, the first commences above the base of the pectoral fin, while their height is subject to considerable variations. These spines may be serrated or even denticulated on their outer edges, and each articulates at its base with an osseous plate, while posteriorly they are connected to the back by a short membrane. Pectoral attached to a broad, flat scapular plate of varying size. Ventral consisting of one spine of inconstant length, and either serrated or smooth, it is attached to the pubic plate, a bony, arrow-headed expansion of the humeral arch which is subject to variation in its width and length. A bony plate ascends from the pubic plate to the lateral scutes. Anal situated beneath the last half of the dorsal: caudal with its posterior extremity square, or rather emarginated. The bony plates along the sides vary considerably in extent, some occupying almost the entire depth of the side, others much less: their numbers likewise vary, as already pointed out, under the head of varieties; they commence behind the occiput and may only be from two (or even none, according to Canestrini) in number, up to thirty-five or even forty. Above these plates are others passing upwards to the back. The situation of the lateral-line likewise varies, being nearer the dorsal profile in some varieties than it is in others. *Cœcal appendages*—a rudimentary one in Gloucestershire examples. *Colours*—in the marine variety the back is of a steel gray, having greenish reflections, becoming golden on the sides and silvery beneath, the fins yellow with fine black dots. In the fresh waters the back is more of a brown gray with golden reflections, and a series of bright spots or vertical bands along the body. During the breeding season the lower part of the head and chest and under surface of the body becomes of a bright pink or red. The females are not so bright coloured as the males. Thompson remarked that full grown fishes, in which the most intense shade of red prevailed, never appear to be with spawn, very few in that state being so much as faintly tinged with it.

Varieties.—In structure these consist in (1) variations in the number of spines forming the first dorsal fin; and (2) variations in the number of bony plates with which the sides are armed. In April or May, 1864, a five-spined stickleback was captured in a stream near Warrington (J. Pears, Zool. p. 9145). Whether, suggests Thompson, a change of habitation, as from fresh water to the sea, would cause the smoothsided at any age to put on the lateral armour, may remain a question. *In colour*—Thompson observes of the varieties *brachycentrus* and *gymnurus*, that of many of the larger individuals captured in Ireland during the

month of September half were red on the under parts; while full-grown fishes, in which the most intense shade of this colour prevailed, never appeared to be in spawn, very few in that state being so much as faintly tinged with it.

Names.—The term *stickleback* appears to be a corruption of the older and far preferable designation of *prickleback*, which well denotes the character of this fish. It is known as *spricklebag* in the north of Ireland, another corruption of the same derivation. The local names are numerous. In the Orkneys, *brandstickle:* Moray Firth, *banstickle* and *bandie:* also *sharplin* in Scotland. In Northumberland *hurry-bannings: pricky* at Northallerton, Yorkshire (Clarke): *Barce*, Yorkshire: *Jack-sharp*, Bury, also *stand*, *taris* or *tanticle* in Suffolk: *stanstickle* and *stuttleback* in some of the eastern counties: *stickling* and *Jack-bannell*,* Oxfordshire (Beesley): the male as *firey-loch*, and the female as *enemy-chit*, in south Hampshire: *hackle*, Devonshire: *bannis* and *banticle*, Wilts: *pow*, Somersetshire. Halliwell adds the following local names but omits the localities, *Jack-sharpling*, *Jack-sharpnails*, and *tittlebat*. It is *Thornback* in the Shannon, and *pinkeen* in the south of Ireland. Couch gives *minnis* as a local name, while others have observed that it is occasionally termed *minnow*, probably due to incompetent observers having mistaken it for the little *Leuciscus phoxinus*. *L'épinoche*, French. *De stekalbaars*, Dutch.

Habits.—Small but voracious, active, and very pugnacious, occasionally descending in large shoals to the estuaries or even the sea. It thrives in a fresh water aquarium but does not appear to live so long in saline water. It has been termed the Ephemera of fishes, and Donovan states it rarely lives beyond the third year. "Yarrell says the stickleback lives only about two years: one of mine has been in the aquarium, I think, nearly double that time, and continues an exceedingly tame and amusing pet" (Zool. 1861, p. 7400). Its favourite haunts seem to be small streams, canals, ditches, and ponds, as well as pools along the sea coast which are liable to be covered at high tides. In Yorkshire it is found in Malham Tarn, at a height of 1250 feet above the sea level (Yorkshire Vertebrata). Nilsson observes that it is captured in great numbers in the Baltic in November, and used for obtaining oil from. Donovan remarks upon having known it taken at a great distance out at sea in the sprat and herring fisheries. It feeds on worms, larvæ, small crustacea, fresh water shrimps, in fact almost anything, even the eggs of its own kind, and, as remarked by Rutty, it destroys the spawn of all sorts of fish, and all the young fry that come in its way. Thompson observed of the varieties *G. leiurus* and *G. brachycentrus*, that contrary to what might have been expected the largest were invariably found where the temperature was lowest. He likewise noted that it and the trout do not seem to co-exist in some of the smaller rivers, or do so very partially. In the stream whence the largest of these was taken, trout a dozen years ago were very common, and the stickleback unknown, and it is only since the almost total disappearance of the trout that this fish has been established in its waters. In a similar stream, issuing from the same mountain range at about a mile distant, the trout yet maintains its place, and in the part of the river frequented by it I have in vain looked for the stickleback. Baker (Phil. Trans. Roy. Soc.) reports that on the 4th of May one devoured in five hours seventy-four young dace, which were a quarter of an inch long and of the thickness of horsehair. Two days afterwards it swallowed sixty-two, and would probably have eaten as many every day could they have been procured for it.

The males appear to be always ready for a fight, but before commencing they swim round each other evidently seeking an unguarded place in their opponent, which found, the attacking party dashes in with great rapidity and uses its spines with great effect, even absolutely ripping his opponent open. A writer in the Magazine of Natural History (iii, p. 330) observes that when a few are first turned into a tub of water they swim about in a shoal, apparently exploring their new habitation. Suddenly one will take possession of a particular corner of the tub, or, as will sometimes happen, of the bottom, and will instantly commence an attack upon his companions, and if anyone ventures to oppose his

* In Warwickshire a closely pronounced name is given to the minnow, *Leuciscus phoxinus*.

sway, a regular and most furious battle ensues, sometimes lasting several minutes before either will give way: and when one does submit, imagination can hardly conceive the vindictive fury of the conqueror, who, in the most persevering and unrelenting way, chases his rival from one part of the tub to another, until fairly exhausted with fatigue.

Mr. Mable at the Weston-super-Mare Museum had some three-spined sticklebacks in an aquarium and some roach, *Leuciscus rutilus*, were added. With this invasion the prior inhabitants were dissatisfied but not frightened, as they forthwith attacked the new comers, biting at them anywhere until they became thoroughly cowed. These little tyrants were observed to place themselves in front of the roach, steady themselves by their tails, and then suddenly dart straight at the lips of their intended prey, from which they bit pieces out. These attacks were continued until all the roach had been killed, when they were eaten by their conquerors (Day, P. Z. S. 1879, p. 753). Mr. Odelly (Hard. Sc. Gossip, 1868, p. 215) mentions placing some carp and tench in a tank containing sticklebacks. Almost immediately these little furies attacked the carp and gave them no rest until they died, which occurred in three or four days, not one of them having more than a vestige of fin and tail left. The tench were left alone.

It has been observed that during the autumn months many adult fish may be found dead, which has been attributed to the love of fighting so very conspicuous in this irritable little race of fishes.

Means of capture.—Young anglers with a stick and short piece of thread on to which is tied a worm by its middle, are very successful in taking many of these fishes in the summer months, as they hold on with great pertinacity to any object which they have once seized. They may also be taken by small meshed nets. Pennant (1776) observed that once in seven or eight years amazing shoals appear in the Welland and come up the river in the form of a vast column. They are supposed to be the multitudes which have been washed out of the fens by the floods of several years, and collected in some deep hole, till overcharged with numbers they are periodically obliged to attempt a change of place. The quantity is so great that they are used to manure the land, and trials have been made to get oil from them. A notion may be had of this vast shoal, by saying that a man employed by the farmer to take them, has got for a considerable time four shillings a day by selling them at a halfpenny a bushel.

*Breeding.**—Although they usually commence doing so in April or May, Thompson remarks having seen one large with spawn in Ireland as late as September: and Wakefield (Zool. 1853, xi, p. 3760) that he has known their eggs hatched in March and April.

Mr. Smee observed of the nest of this species as found in the river in his garden, that it was merely a thin covering of fibres arranged over a hole placed in a hollow. The Curator of the Norwich Museum observed (1857) of some in an aquarium, that the male having selected a spot in the centre of the trough, here he made a collection of delicate fibrous material resting on the ground and matted into an irregularly circular mass, somewhat depressed and upwards of an inch in diameter,† the top being covered with similar materials and having in the centre a rather large hole. He kept constant watch over the nest, every now and then shaking up the materials and dragging out the eggs, which were the size of poppy seeds, and then pushing them into their receptacle again and tucking them up with his snout, arranging the whole to his mind, and again and again adjusting it until he was satisfied: after which he hung or hovered over the surface of the nest, his head close to the orifice, fanning it with his pectoral fins aided by a slight motion of the tail. Mr. Kinahan (Zool. p. 3526) says the male selects a suitable spot where the water, not too deep, runs with a current over a gravelly bottom. The foundation is usually laid of straws, having their ends carefully tucked into the gravel: other straws are laid across and similarly secured by the

* The first British naturalist who wrote about the nests of sticklebacks was Richard Bradley, F.R.S., in 1721, in his Philosophical Account of the works of Nature, p. 61, London, 4to.

† In the Youth's Instructor for 1834, the size of these nests as found in the London Docks was given as "somewhat larger than a shilling."

fish placing his snout on the end of each straw, and then raising his body vertically to press it down. Confervæ and such like are then woven into a mass above, through which the water can have free passage. In the centre of this, a dome-like hollow is preserved, and on the top a small round hole whose edges are strengthened with particular care, and rounded off by tucking in the loose fibres.

From this time as described by Mr. Warrington (Ann. Nat. Hist. (2) xvi, 1855, p. 350) the nest was opened more and more to the action of the water while the male hovered over it, causing a current of water to be propelled across the surface of the ova, this action being almost constantly repeated. After about ten days the nest was destroyed and minute fry appeared and were guarded by the male. (Other observers have found the eggs to take three weeks or nearly a month before they were hatched.) Also if the young fish strayed above a certain distance from the nest they were brought back by puffing at them by the male. As soon as the yelk bag became absorbed and they could swim he gradually relaxed his efforts.

They have also been observed to select, as suitable places for constructing their nests, rock pools which are only reached by the spring tides. Here the temperature of the water is considerably increased by the heat of the sun, and the young are hatched and reared in comparative security.

Diseases.—Mr. Wolley (Zool. 1847, p. 1649) mentions a disease among the sticklebacks in a pond near Liverpool: it appears as large globular excrescences each the size of a peppercorn, but taken together equalling the size of the body of the fish. The fish are small and ill-conditioned. Tait (Journ. Anat. and Phys. v, 1869, p. 12) has described how these fishes are affected by tumours, which are soft and sensitive, impeding the movements of the fish.

Thompson (Nat. Hist. Ireland, iv, p. 87) observed that the largest examples of the variety *G. brachycentrus*, invariably found where the temperature was lowest, were perfectly free from the pearl-like tumours which adhere to the body and infest those inhabiting the comparatively warm waters of the lower grounds.

It has been observed that wounds received from one another in conflicts at first become white, then increase in extent until the whole fish is covered with a furry-looking fungus (Wakefield, Zool. 1853, xi, p. 3760).

Mr. Poole (Nature, Sept. 1881, p. 485) remarks having found these fish in a pond at Godalming infested by numbers of Infusoria, evidently parasitic, upon them. The parasite being apparently *Trichodina pediculus* which previously had only been known to be parasitic on fresh water Polypes, as the *Hydra*, but which it now seems also employs the stickleback as its host.

Uses.—In Eastern Russia, also in the Baltic, numbers are collected during November, when they assemble on the coast in shoals prior to seeking their winter quarters. They are boiled down, a bushel, it is reported, giving about two gallons of oil, and the refuse fish is employed as manure. Near Dantzic they are likewise said to be used for feeding ducks and fattening pigs. In Kamtschatka and in Rupert's Land they are stored up for the winter food of dogs.

As food.—A nourishing soup it has been observed may be made from sticklebacks.

Habitat.—Greenland, Northern Europe, and North America. In the Orkneys found in even the smallest brook, lock, or puddle that has a running communication with any other piece of water (Low). It is common not only inland but all round the coasts of Great Britain and Ireland.

The marine, semi-marine, and estuary varieties have been specially recorded from the following localities. Variety *trachurus* around the coast in salt or brackish waters: common in the Orkneys and Zetland: Banff (Edward): Aberdeen (Sim) St. Andrew's: Aberlady, but not common in the Firth of Forth, frequent at Berwick-on-Tweed (Parnell): also found in Ayrshire (Thompson): abundant in Yorkshire (Clarke): swarms in Lincolnshire and common in Norfolk: mouth of the Thames: Isle of Wight (More): Weymouth (Gosse): Devonshire, Cornwall, and Somersetshire. In Ireland this form and also the variety *semiloricatus* are found as marine or estuary residents in the island of Rathlin. The typical *trachurus* has been taken in Larne Lough: Belfast Bay

and the harbour of Donaghadee in Ireland (Thompson). The variety *semiarmatus* has been recorded from Aberdeen (Sim): St. Andrew's: is rather rare on the coasts of Scotland, but has been found in the marshes below Kincardine. Somersetshire (Baker): Weymouth (Gosse). In Ireland it is also considered among the rarest of the marine or semi-marine forms, but has been taken at the Island of Rathlin and at Wolfhill near Belfast (Thompson).

The inland or smooth-tailed varieties are also found in the vicinity of the sea, and some have been said to have been taken in brackish and saline waters. Variety *gymnurus* is certainly most widely distributed throughout Great Britain and Ireland. It is found in the Orkneys (Baikie): Banff (Edward): Aberdeen (Sim): common in the Firth district (Parnell): Berwick-on-Tweed: Isle of Arran: Portpatrick (Thompson): Isle of Wight (More, Zool. 1861, p. 7303): Weymouth (Gosse), several places round Exeter and Topsham Marshes (Parfitt), Devonshire: Somersetshire (Baker): Bristol (Couch): Mr. Witts obtained a number for me from Slaughter on the Cotteswolds, it is also found round Cheltenham: while out of a hundred and forty sticklebacks taken from a trout stream at Warrington, in Lancashire, about half were this form the others being *G. pungitius* (J. Peers, Zool. 1864, p. 9145). In Ireland this is the commonest form throughout the country, and Thompson records it from the island of Rathlin, Belfast, the river Bann at Toome: from county Down and Fermanagh: Dublin: county Wicklow: Queen's county: and Cork. I found them also very abundant at Longford. Thompson has also taken them from drains, which are occasionally replenished by the tide. The variety *brachycentrus* has been captured at Stowpool, near Lichfield (Thompson). I took some at Edgeworthstown, county of Longford: while Thompson records it from Lough Neagh, Belfast, Dublin, Youghal, Portarlington. The variety *spinulosus* has been recorded from the Firth of Forth, South Queensferry, Guillon Links, Dudlington Loch, and Berwick-on-Tweed (Parnell): in some numbers from near Edinburgh (Stack): Norwich (Dunn): Teignmouth (Walcott): common in Cornwall, ascending the river in May (Cornish Fauna). In Ireland I have taken it at Edgeworthstown: at Portarlington, in Queen's county, and Belfast (Thompson).

This species in the British Isles does not appear to have been recorded over $3\frac{1}{2}$ inches in length.

2. Gasterosteus pungitius, Plate LXVIII, fig. 4.

Pisciculi aculeati alterum genus, Rondel. ii, p. 206. *Pisciculus pungituris*, Gesner, fol. 160*a*. *Pisciculus aculeatus minor*, Willughby, p. 342; Ray, p. 145. *Pungitii alterum genus*, Aldrov. v, c. 36; Jonston, t. xxviii, f. a.

Gasterosteus, no. 2, Artedi, Spec. p. 97; Gronov. Zooph. no. 406. *Ten-spined stickleback*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 262, pl. l and (Ed. 1812) iii, p. 355, pl. lxi.

Gasterosteus pungitius, Linn. Syst. Nat. i, p. 491; Bl. ii, p. 108, t. liii, f. 4; Bl. Schn. p. 123; Bonnaterre, Enc. Ich. p. 137, pl. lvii, f. 225; Lacép. iii, p. 297; Donovan, Brit. Fish. ii, pl. xxxii; Shaw, Zool. iv, p. 606, pl. lxxxvii; Pallas, Zoogr. iii, p. 228; Turton, Brit. Faun. p. 101; Flem. Brit. Anim. p. 219; Cuv. and Val. iv, p. 506; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 409; Thompson, An. and Mag. Nat. Hist. 1841, vii, p. 103, and Nat. Hist. Ireland, iv, p. 89; Ekstr. Fische Mörkö, p. 159; Fries och Ekstr. p. 20, pl. iv, f. 2; Kröyer, Dan. Fiske, i, p. 188, c. fig.; Yarrell, Brit. Fishes (Ed. 1) i, p. 85, c. fig. (Ed. 2) i, p. 99 (Ed. 3) ii, p. 91; Storer, Fish. of Mass. p. 32; Jenyns, Man. p. 350; Parnell, Fishes Firth of Forth, p. 37, pl. xxvi, and Wern. Mem. vii, p. 197, pl. xxvi; White, Catal. Brit. Fish. p. 36; Gronov. ed Gray, p. 167; Nilss. Skan. Fauna, Fiske, p. 110; Blanchard, Poiss. France, p. 238, c. fig.; Günther, Catal. i, p. 6; Schlegel, Dieren Neder. p. 54, pl. iv, f. 5; H. Malmgrem, Wiegm. Arch. 1864, p. 282; Collett, Norges Fiske, p. 13; Day, Jour. Linn. Soc. 1876, p. 110; Houghton, British Fresh-water Fishes, p. 13, c. fig.; Winther, Ich. Dan. Mar. p. 4.

Leiurus pungitius, Swainson, Fishes, ii, p. 242.

Gasterostea pungitia, Sauvage, Revis. Epin. 1874, p. 29; Moreau, Poiss. France, iii, p. 169.

Tinker, Couch, Fish. Brit. Isles, i, p. 176, pl. xxxvii, fig. 2.

American variety.

Gasterosteus occidentalis, Cuv. and Val. iv, p. 509; De Kay, New York Fauna, p. 68, pl. xlii, f. 135.

Gasterosteus pungitius, Storer, Rep. Mass. p. 32.

Gasterosteus nebulosus, Agassiz, Lake Superior, p. 310, pl. iv, f. 2.

Pygosteus occidentalis, Brevoort, Amer. Fish. Report, 1873, p. 794.

Abnormal varieties.

Gasterosteus pungitius, Day, Jour. Lin. Soc. 1876, Zool. p. 110 (*Destitute of ventral fins*).

B. iii, D. 7-10/$_{\frac{1}{9\text{-}10}}$, P. 10, V. 0-1, A. $_{\frac{1}{8\text{-}10}}$, C. 12.

Length of head $3\frac{3}{4}$ to $4\frac{1}{3}$, of caudal fin $5\frac{2}{3}$ to $7\frac{1}{4}$, height of body $5\frac{1}{4}$ to $6\frac{1}{4}$ in the total length. *Eye*—diameter $3\frac{1}{4}$ to 4 in the length of the head: $1\frac{1}{2}$ to 2 diameters from the end of the snout, and 3/4 of a diameter apart. This species is more elongated than *G. aculeatus*. The maxilla extends posteriorly to beneath the front edge of the eye. *Teeth*—villiform in the jaws, more numerous anteriorly than they are laterally, none on palate or tongue. *Fins*—the spines of the first dorsal of varying length, but low, being about equal to half the height of the rays of the soft dorsal, the last of which are the longest. It has been stated that these spines are not in a straight line one behind the other, but that alternate ones are more to the right or left; this I have not been able to confirm in all the examples which I have examined: their edges are smooth. Caudal square or slightly emarginate at its posterior extremity. Ventrals consisting each of one spine and one ray when present, and which articulate with the pubic plate: an arrow-headed expansion of the humeral arch, which is subject to great variation both as to its width and length, and may even be entirely absent. The sides, as a rule, are entirely smooth, but in some few instances an indistinct caudal keel has been observed. *Colours*—vary considerably, usually of a dark olive-green or brown along the back, becoming lighter on the sides and beneath, with numerous black spots and dots irregularly distributed: fins diaphanous. In the breeding season, those which I have seen become much darker, the under surface of the head and chest turning to a cobalt blue. They are said to assume their nuptial livery about March: Nilsson observes that in Scandinavia they become red at this period.

Varieties.—In form.—Allman obtained in Tipperary several specimens of a stickleback, apparently referrible to *G. pungitius*, but without any trace of ventral spines (Thompson): subsequently I captured thirteen examples of this species at Edgeworthstown, all having a badly marked keel on the side of the tail; eleven of these were destitute of ventral fins. When the spine existed, as a rule it was not half the length of the pubic plate: in one example the spine on one side of the body was one-third shorter than its fellow on the opposite side. In those wherein no ventral spine existed the pubic plate was also absent. The Swedish variety, though generally possessing 9 dorsal spines, has been observed to have them from 8 to 10. Jenyns considered that in the British Isles there are two varieties, the first with the "sides of the tail keeled; each keel being furnished with several slender scales, which themselves appear scaled under the microscope: secondly *G. lævis*, Cuv. and Val. having the sides of the tail quite smooth."

Donovan observed that we have in some 10 dorsal spines, others with 9, while one specimen had only 8. Shaw also remarks that sometimes, though but rarely, the spines amount to 11. Parnell took two at Prestonpans, one having 9, the other 11 dorsal spines. Among those I personally obtained at Edgeworthstown, and which varied from 1·4 inches to 2·1 inches in length, one had 2 dorsal spines, only the seventh and ninth being visible: one had 4 spines, and eleven had 8 to 9 spines. Thus we have local instances wherein the dorsal spines numbered 2, 4, 8, 9, 10 and 11.

Names.—*Ten-spined stickleback*, thus termed due to the usual number of spines in the dorsal fin. *Tinker*. *L'épinochette*, French.

Habits.—This form is smaller and not so generally distributed as the three-spined species, but appears to be equally irritable. Couch asserts that it will not exist when confined in salt water, however diluted such may be.

Means of capture.—Similar to those employed for the three-spined stickleback.

*Breeding.**—D'Orbigny considered that this species of stickleback invariably constructed its nest upon aquatic plants or among their roots, likening that of *G. aculeatus* to a molehill, and of *G. pungitius* to a muff, or as observed by Yarrell, to the nest of a wren or a long-tailed tit. On May 1st, 1864, a male of this species was placed by Mr. Ransom (Annals and Mag. Nat. Hist. 1865, xvi, p. 449) in a well-established aquarium of moderate size, and in which, after three days, two ripe females were added. He soon began to build a nest of bits of dirt, dead fibre and growing confervoid filaments, upon a jutting point of rock, among some interlacing branches of *Myriophyllum spicatum*, all the time, however, frequently interrupting his labours to pay his addresses to the females. This was done in most vigorous fashion, he swimming by a series of little jerks near and about the female, even pushing against her with open mouth, but usually not biting. After a little coquetting, she responds and follows him, swimming just above him as he leads the way to the nest. When there the male commences to flirt, which he after a time terminates by pushing his head well into the entrance of the nest, while the female closely follows him, placing herself above him and apparently much excited. As he withdraws she passes into the nest, and after a very brief delay pushes quite through it, during which she deposits her ova. The male now fertilizes the eggs, and drives the female away to a safe distance: then, after patting down the nest, he, being polygamous, proceeds in search of another wife. The nest is built and the ova deposited in about twenty-four hours. The male continues to watch it day and night, and during the light hours he also continually adds to the nest.

Uses.—Similar to those of the three-spined species.

Habitat.—Newfoundland common (Saxby, Zool. 1871, p. 2533), throughout Europe, also found in the northern parts of America from Newfoundland to Cape Hatteras.

In Great Britain and Ireland, this species, although widely distributed and often locally abundant, is not so general as the varieties of *G. aculeatus*. It is said to have been obtained in Zetland (W. Baikie): Portpatrick (Thompson). Has been found near Leeds, Doncaster, Ulleskelfe, Thirsk, Slingsby, Redcar, and Urome (Yorkshire Vertebrates): in ditches in Norfolk near Lynn, but not very common (Lowe): at Warrington in Lancashire (J. Peers): Leam near Leamington (Thompson): Preston Weald-moors, in Shropshire (Houghton): Battersea fields and Cobham, in Surrey (White): estuaries of the Thames (Thompson): Isle of Wight (More): occasional in Devonshire (Parfitt).

In Ireland it is rare as compared with the three-spined form (Thompson). It has been recorded from Portaferry, county Down: Blackstaff river, near Belfast: La Bergerie, Queen's County: Youghal and Dublin.

The example, figured life size, is one of the Irish variety, wherein ventral the spines and pubic plate are absent. It was obtained at Edgeworthstown, county of Longford. This species is said to rarely exceed 2 or $2\frac{1}{2}$ inches in length.

3. Gasterosteus spinachia, Plate LXVIII, fig. 5.

Aculeatus vel Pungitius marinus longus, Schonev. p. 10, t. iv, f. 3; Will. p. 340; Ray, p. 145. *Gasterosteus*, no. 3, Artedi, Genera, p. 52; Gronov. Zooph. no. 407. *Centriscus*, sp. Klein, Pisc. Miss. iv, p. 48, no. 1, t. iv, f. 5. *The fifteen-spined stickleback*, Low, Fauna Orcad. p. 217; Pennant, Brit. Zool. (Ed. 1776) iii, p. 263, pl. l and (Ed. 1812) iii, p. 356, pl. lxi.

* On its nidification see Landois, Zool. Gart. 1870, p. 1-10.

Gasterosteus spinachia, Linn. Syst. Nat. i, p. 492; Bloch, t. liii, f. 1; Bl. Schn. p. 123, t. xxxiii, f. 2; Bonnaterre, Atl. Ich. p. 137, pl. lvii, f. 226; Lacép. iii, p. 301; Donovan, Brit. Fish. ii, pl. xlv; Shaw, Zool. iv, p. 607, pl. lxxxvii; Turton, Brit. Fauna, p. 101; Cuv. and Val. iv, p. 509; Ekstr. Fische Mörkö, p. 163; Kröyer, Dan. Fiske, i, p. 193, c. fig.; Fries och Ekstr. p. 21, t. iv, f. 3; Jenyns, Manual, p. 351; Yarrell, Brit. Fish. (Ed. 1) i, p. 87, c. fig. (Ed. 2) i, p. 101 (Ed. 3) ii, p. 93; Thompson, An. and Mag. Nat. Hist. 1841, vii, p. 104, Natural Hist. Ireland, iv, p. 89; Parnell, Wern. Mem. vii, p. 38, pl. xxvi, and Fish. Firth of Forth, p. 198; Johnston, Berwick. Nat. Club, 1838, i, p. 171; Nilss. Skan. Fauna, Fiske, p. 112; White, Catal. Brit. Fish. p. 36; Günther, Catal. i, p. 7; Schlegel, Dieren Neder. p. 54, pl. iv, f. 3; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Edin. v, 1862-66, p. 614, and Fish. St. Andrew's, p. 171.

Spinachia vulgaris, Flem. Brit. Anim. p. 219; Johnston, Fish. Berwick. Mag. Nat. Hist. 1833, vi, p. 15; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 409; Malmgren, Wieg. Arch. 1864, p. 282; Collett, Norges Fiske, p. 14; Winther, Ich. Dan. Mar. p. 5; Moreau, Poiss. France, iii, p. 171, c. fig.

Polyacanthus spinachia, Swainson, Fishes, ii, p. 242.

Gasterosteus marinus, Gronov. ed. Gray, p. 168.

Gastrœa spinachia, Sauvage, Revis. Epin. An. Mus. 1874, p. 36.

Fifteen-spined stickleback, Couch, Fish. Brit. Isles, i, p. 180, pl. xxxviii.

B. iii, D. 15(-17)/6-7, P. 9-10, V. 1/1, A. 6-7, C. 12-14, Vert. 18/23.

Length of head 4 to $4\frac{1}{2}$, of caudal fin 8, height of body $8\frac{1}{2}$ to 9 in the total length. *Eye*—situated very slightly behind the middle of the length of the head, 2 to $2\frac{1}{2}$ diameters from the end of the snout, and 1 apart. Body elongated and posteriorly depressed. Snout elongated. Mouth short: the posterior extremity of the upper jaw does not extend half way to beneath the front edge of the eye. *Teeth*—present in both jaws, of a moderate size, compressed and having the summits notched, some anteriorly being tricuspidate: none on the vomer, palatines, or tongue. *Fins*—the first dorsal is formed of free spines of about equal height, each situated on an osseous plate, a row of which extends from the occiput to the base of the caudal fin: second dorsal and anal short and somewhat similar to one another: caudal square or rounded at its extremity. Ventral with one spine and a single ray. The soft rays of the dorsal, anal, and caudal fins are simply divided at their extremities, those of the pectoral being undivided. *Scales or armature*—along the side of the body exists a raised ridge, consisting of about 40 wide plates, having a central elevation and slightly roughened keel. A second but smaller ridge also goes from the posterior edge of the dorsal fin to the middle of the upper edge of the caudal: a third ridge, similar to that of the dorsal, passes from the anal to the lower edge of the caudal fin. Respecting the existence of two cœcal appendages, as observed by Valenciennes and others, they were absent in the British specimens which I have examined. *Air-bladder*—simple, rather wide posteriorly and narrow anteriorly, having a very silvery appearance. *Colours*—olive, becoming silvery beneath: a brilliant silvery stripe passes from the snout to beneath the eye, bounded above by a dark line which is continued posteriorly some distance along the side: this brilliant white band is often broken up into irregularly oval spots continued to above the commencement of the anal fin. Under surface of chest and as far as the anal fin yellow. Irregular dark bands sometimes cross the body, and are generally most distinct in the caudal portion: second dorsal and anal brown in their outer two-thirds, or with a short band. Caudal dark, with a light upper edge. This fish, says Dr. Ball, possesses the chameleon-like quality of changing colour when excited.

Varieties.—Edward records having seen examples at Banff possessing sixteen and seventeen dorsal spines.

Names.—Its local name *bismore*, in the Orkneys is derived from a kind of balance used there and which has this designation (Low). *Willie-wan-beard*, Banff (Edward), or *Robbie wamberg*, Banff (Yarrell). *Bottle-nose*, St. Andrew's: *Duckins*, Berwick: *Great sea-adder*, west country and Cornwall. *L'épinoche de mer*, French. *De zee stekelbaars*, Dutch.

Habits.—This is a marine species, the limit of whose existence has been erroneously fixed at one year (Lloyd). Occasionally it strays into brackish waters, and has been said to have ascended a short distance up rivers, but this is denied by most authors. But its most common residence appears to be along the bases of sea-weed covered rocks, or among the stems of fuci at the sea bottom, although it is sometimes found in rock pools and under stones between tide marks. It feeds on worms, small crustacea, the eggs and fry of other fish, and animal substances. Yarrell found in them numerous examples of the opossum shrimp, *Mysis.* At the Westminster Aquarium (Dec. 1879) some might occasionally be seen floating along in a perpendicular manner, the head being uppermost: or else quite still on some marine plant, retaining the same position, or the head might be occasionally downwards. They do not move their fin rays in the rapid manner of the *Hippocampus.* Couch observed one under the influence of terror change from a dark olive with golden sides to a pale hue, and so remain for eighteen hours.

Means of capture.—Dredging, trawling, shrimp nets, and found under stones and among sea-weed at low water.

Breeding.—In spring in some quiet spot as a harbour or place where the water is pure but the locality sheltered from the violence of the waves, or even between tidemarks where the nest may be left uncovered for two or three hours at a time. The form of the whole structure is pear-shaped and about the size of a man's fist. Admiral Milne, in the Edinburgh Philosophical Journal, writing on fishes' nests evidently refers to that of the fifteen-spined stickleback. Dr. Swainson considered them to have been constructed by gobies, but Mr. Maclaren had assured him that he had watched the stickleback in the act of making them. In an aquarium this fish commences constructing its nest in the spring, but it is never completed. The fifteen-spined stickleback usually chooses as a foundation for its nest the over-hanging branch of a sea-weed, and one was observed to have selected the loose end of a rope, from which the separated strands hung at about a yard below the surface over a depth of four or five fathoms. Either the materials at hand are employed or the fish collects some of the softer sea-weeds which it joins together with so much of the coralline tufts, *Janiæ*, as will be sufficient to afford the required firmness. It stitches the materials together with a thread, the material employed being very elastic and which has been likened in appearance to silk. This nest is watched over by the parent fish, supposed to be the male, which does not leave its station but continues guard for three or four weeks until the young are able to shift for themselves.

As food.—It is worthless, while its sides are too well protected even for bait. It is used as manure and for obtaining oil from.

Habitat.—From the coasts of northern Europe, especially the North Sea and Baltic: in vast numbers off Holland: along the coasts of France: it is found round the British Isles, also off the English Channel to the Bay of Biscay.

In the Orkneys and Zetland it is very frequent. It breeds at Wick (Peach): common among the pools at Banff (Edward): at Peterhead (Yarrell): Aberdeen (Sim). Only two instances have been recorded from the Moray Firth (Gordon, Zool. 1852, p. 3458): abundant in rock pools at St. Andrew's (McIntosh): Firth of Forth (Neill). By no means uncommon on the coast of Berwickshire (Johnston): similarly numerous along that of Yorkshire (Yorkshire Vertebrata): at Yarmouth it has been said to be rare (Paget): it is uncommon along the Sussex coast: at Weymouth it is abundant around the quays (P. Gosse): Plymouth and south coast (Parfitt): Dawlish: and common in Cornwall (Cornish Fauna): a local example exists in the Weston-super-Mare Museum: and the fry have been observed on the coast of Anglesea (Donovan).

In Ireland it is found all round the island, most being taken on the south coast where sprat fishing is most practised. Thompson had examples from Rathlin in the north: Down and Antrim: Bundoran on the west and Youghal on the south.

The example figured, life size, was from Shoreham. It attains to at least 7 inches in length.

Twelth group—Acanthopterygii centrisciformes.

Snout tubular: mouth small. Two dorsal fins, the anterior spinous and short: the soft dorsal and the anal each with a moderate number of rays. Ventral fins abdominal, and imperfectly developed.

Family, XXVII—CENTRISCIDÆ, *pt. Bleeker.*

Fistularia, pt. Müller; *Amphisiloidei*, pt. Bleeker.

Branchiostegals three or four: pseudobranchiæ present. Gills four. Form of body oblong or elevated and compressed. The anterior bones of the skull forming an elongated tube, having a small terminal mouth. Teeth absent. Two dorsal fins, the first short with one of its spines strong: soft dorsal and anal of moderate extent: ventral abdominal, spineless and rudimentary. Scales, when present, small: the body often covered with a cuirass or ossifications that are not confluent with one another. Air-bladder large. Pyloric appendages absent Vertebræ few.

This family has been divided into two genera. (1) *Centriscus*, in which the body is scaled or covered with prickles. (2) *Amphisile*, without scales but invested with a bony cuirass.

Geographical distribution.—South coast of Great Britain to the Mediterranean, coasts of Africa, Indian Ocean, North and South Pacific.

Genus I—Centriscus, *Linnæus.*

Branchiostegals four: pseudobranchiæ present. Body oblong or elevated and strongly compressed. Teeth absent. Two dorsal fins, one of the spines of the first being strong and elongated: ventral with five rays, small and abdominal. Some small rough scales on the body, and narrow bony prolongations on the sides or dorsal aspect, while others pass upwards to the back: also a carinated keel along the lower edge of the chest and abdomen. Lateral-line absent. Air-bladder large. Pyloric appendages absent.

Geographical distribution.—This genus extends from the southern shores of Britain to the Mediterranean, the Japanese waters and Tasmania.

1. Centriscus scolopax, Plate LXIX.

Scolopax, Rondel. De Pisc. xv, c. 5, p. 422; Aldrov. iii, c. 13, p. 298; Jonston, i, tit. 1, cap. 1, art. 4, t. i, f. ix. *Trumpet-fish*, Willughby, p. 160, t. i 25, f. 2; Ray, p. 50; Couch, Linn. Trans. xiv, p. 89, Brit. Fish. iii, p. 21, pl. cxxiv. *Solenostomus*, no. 1, Klein, Miss. Pisc. iv, p. 24. *Snipe-nosed trumpet-fish*, Penn. Brit. Zool. (Ed. 1812) iii, p. 190. *Silurus cornutus*, Forsk. p. 66. *Centriscus*, sp. Gronov. Zooph. no. 395.

Centriscus scolopax, Linn. Syst. Nat. i, p. 415; Brünn. Pisc. Mass. p. 8; Bloch, i, p. 55, t. cxxiii, f. 1; Bl. Schn. p. 112; Bonn. Atl. Ich. p. 30, pl. xxi, f. 69; Lacép. ii, pp. 86, 95, i, pl. xix, f. 3; Donovan, Brit. Fish. iii, pl. lxiii; Turton, Brit. Fauna, p. 117; Shaw, Nat. Misc. xiv, pl. 584, and Zool. v, p. 459, pl. clxxxi; Flem. Brit. Anim. p. 220; Cuv. Règne Anim.; Jenyns, Manual, p. 400; Yarrell, Brit. Fish. (Ed. 1) i, p. 302, c. fig. (Ed. 2) i, p. 346 (Ed. 3) ii, p. 190; Risso, Eur. Mérid. iii, p. 476; Guérin, Icon. Poiss. pl. xlv, f. 2; Martens, Reise nach Venedig, ii, p. 436; White, Catal. p. 45; Gronov. ed. Gray, p. 138; Günther,

Catal. iii, p. 518, and Ann. and Mag. Nat. Hist. (4) xvii, p. 395; Canest. Faun. Ital. p. 137; Steind. Ich. Span. u. Port. 1868, p. 21; Gill, Amer. Fish. Report, 1873, p. 793; Giglioli, Pesc. Ital. p. 33; Moreau, Poiss. France, iii, p. 175.

Macrorhamphosus cornutus, Lacép. v, pp. 136, 137.

Solenostomus scolopax, Risso, Ich. Nice, p. 80.

Trumpet-fish, Couch, Fish. Brit. Isles, iii, p. 21, pl. cxxiv.

B. iv, D. 5-7/11-12, P. 16, V. 5, A. 19-20, C. 6+9+6, Vert. 8/16.

The length of the head equals or rather exceeds its distance from the base of the caudal fin: of the caudal fin 3½ to 4 in the length of the head: height of body equal to about 1/2 the length of the head. *Eye*—diameter equal to the postorbital length of the head, 3/4 to 1 diameter apart. Body compressed: snout likewise compressed and elongated into a tube, terminating anteriorly in a small mouth, with an oblique cleft and the lower jaw somewhat anterior. Preopercle oblique and finely serrated. Serrations likewise present along the anterior half of the lower margin of the orbit. *Teeth*—absent. *Fins*—first dorsal commences midway in the distance between the end of the opercle and base of the caudal fin, its first spine short: its second long and compressed, equalling in length rather above 1/2 the length of the body excluding the head and caudal fin: striated laterally, serrated posteriorly, its last three spines very short: the first two rays of the second dorsal are shorter than the next three, the remainder decrease in length to the last, all undivided. Pectoral twice as long as the eye, its rays unbranched. Ventral small, with five rays, and receivable into a groove. Caudal emarginate. *Scales*—small, ridged, and each ridge having a spinate termination: they are present over the body, head, and base of the snout, while some minute ones are found along the outer third of the eye, except in its anterior fourth. Abdominal edge sharp, cutting, compressed, and with a few spines along its lower margin. *Colours*—rosy dashed with golden, darkest along the back where it is sometimes of an olive tint: sides and lower surface silvery.

Names.—The *trumpet*, *bellows-fish*, *woodcock* or *snipe-fish*. *Bécasse*, French.

Habits.—Resides at a moderate depth preferring a muddy bottom. It is a slow swimmer, while due to the size of its mouth it must live on minute substances.

Breeding.—In the Mediterranean during the spring (Risso): the young being seen near shore in the autumn, when they are of a bright silvery colour.

As food.—Donovan observes the flesh is very palatable and wholesome, according to the accounts of those who have visited the south of Europe, and eaten them, but being small they are esteemed of little value.

Habitat.—A stray wanderer to the south coast of Britain, and is found in the Mediterranean, where, however, it does not appear to be numerous. An example has likewise been taken at Massachusetts: and a specimen has been received at the British Museum from Tasmania.

Respecting the number of British specimens it does not seem impossible that they may have been unduly multiplied, and the similarly coloured boar-fish, *Capros aper*, which was first recognized in Cornwall in 1825, has been recorded as a *Centriscus;* for instance, the fragment found in Mount's Bay in 1853, which was too imperfect for preservation. Sir T. Brown observes upon one having been given him by a seamen of these seas, which may have been from Norfolk, but proof of this appears to be wanting. An undoubted British example, 5 inches in length, was thrown on shore at Menabilly, near Fowey in St. Austell's Bay, Cornwall, in 1804, and which was recorded in Pennant's second edition, 1812: it is not improbable that this may be one of those referred to by Donovan, who in 1804 observed, "We are acquainted with one or two, if not more, well authenticated instances of its having been observed on the western coast of England, about Devonshire and Cornwall," but he does not seem to have personally examined the fish. Mr. R. Couch is alluded to by Yarrell as an authority for two more Cornish examples, but his statement is as follows: "Mr. Chergwin told me that he had seen a specimen taken in Mount's Bay, and a fisherman tells me he has taken another off Cape Cornwall" (Zoologist, 1847, p. 1612). Thus the evidence of Mr. R. Couch is merely given at second hand.

Thirteenth group—Acanthopterygii pharyngognathi.

The two inferior pharyngeal bones are generally anchylosed into one with or without a median longitudinal suture. Air-bladder destitute of a pervious pneumatic duct.

Müller separated from the remainder of the hard-rayed or Acanthopterygian fishes, under the designation of *Pharyngognathi*, such families as he observed had the inferior pharyngeal bones coalesced into one, as in *Pomacentridæ*, *Labridæ*, and *Chromides*. But a more extended investigation has since shown that this division is inadmissible. Thus in genus *Gerres*, wherein the inferior pharyngeal bones were found to be usually as defined in the *Pharyngognathi*, Kner pointed out that *Gerres macrosoma* is an exception, and Professor Peters has recorded the same fact of *G. plumieri*. If such a character is unreliable within the limits of a single genus, it can scarcely be accepted as a ground upon which to institute a sub-order of fishes.

Family, XXVIII—LABRIDÆ, *Cuvier*.

Labroidei cycloidei, Müller; *Scaroidei*, Cantor; *Cyclolabridæ*, Owen.

Branchiostegals five or six: pseudobranchiæ present. Gills three and a half. Body oblong or elongated. Teeth in the jaws: palate edentulous: lower pharyngeal bones anchylosed along the median line into one, without any median suture. A single dorsal fin, with usually as many or more spines than rays: the anal rays generally similar to those of the dorsal: ventral thoracic with one spine and five rays. Scales cycloid. Lateral-line complete or interrupted. Air-bladder present, without pneumatic duct. No cæcal sac to the stomach. Pyloric appendages absent.

Geographical distribution.—These littoral fishes, known as *wrasses* or *rock-fish*, appear to be exclusively marine and confined to the seas of tropical and temperate regions, being nearly absent from those of colder climes. Around the British Isles they are generally found in the vicinity of rocks, and appear partial to such as are covered by sea-weeds.

Many of the wrasses, termed *Labridæ* due to size of their lips, are adorned with gorgeous tints, the intensity of which is greatly augmented during the nuptial period, usually about May. They are also subject to great individual variations in the mode in which they are coloured, while in some the livery of the two sexes is very dissimilar. Variations in form are not unusual among these fishes; thus the head in certain species is comparatively longer in the young than in the adult. Some of the soft rays may be transformed into spines, as I have already observed occurs among the *Serrani* and *Sparidæ* (p. 14): the height of the spines as compared to the rays is greater in the young than in adults. The preopercle may be serrated in the young, but smooth in the adult. They are provided with exceedingly strong teeth to enable them to crush the shells of marine molluscs and crustacea, while some feed on corals, others on zoophytes or even sea-weeds. A few are provided with a pointed tooth directed forward, and placed at the angle of the mouth, which is supposed to be employed for pressing shells against the lateral and crushing teeth.

As food they cannot be recommended for their superior flavour, while their flesh is soft, somewhat sweet, and rapidly decomposes. Mr. Birchell (Zool. 1876, p. 5160), however, observes that speaking from experience he can say that they are excellent eating, and at the present day are largely consumed and much

esteemed in southern Europe, where they form the chief ornament of the fish-markets: *Coris julis* is known at Naples as *Cazzillo di re*. The Greeks asserted that it is not easy to do justice to its flesh, to sufficiently praise its trail is impossible, and to throw away even its excrement a sin.

Aristotle observed that like quadrupeds the wrasses ruminated during the day and slept at night time. In some genera if one were hooked its friends bit through the fisher's line, and were it enclosed in a net they introduced their tails in order to assist escape. The male was supposed to keep watch over several females whom he only left to their own devices for a few hours every evening when he went to search for food for himself. The term wrass, by which these fishes are generally known in Great Britain, is pronounced *wrath* or *rath* by the fishermen of the west of England. Near the Lizard, Mr. Johns observes they are termed *raagh*, which, as Couch remarks, may be an ancient British word, approaching to the Welsh *gwrach*, signifying an "old woman."

The British genera of this family may be recognized as follows:—

Dorsal spines 13 *or more.*

1. Teeth in a single row: imbricate scales on cheeks and opercles. Anal spines 3. Lateral-line exceeding 40—*Labrus.*

2. Similar to *Labrus*, but the scales along the lateral-line are less than 40—*Crenilabrus.*

3. Teeth in the jaws in a band: imbricate scales on cheeks and opercles. Anal spines 3—*Ctenolabrus.*

4. Teeth in the jaws in a band: imbricate scales on cheeks and opercles. Anal spines more than 3—*Acantholabrus.*

5. Teeth in the jaws in a single row: imbricate scales on cheeks and opercles. Anal spines more than 3—*Centrolabrus.*

B. *Dorsal spines* 9.

6. Scales small: none on the head—*Coris.*

Genus 1.—Labrus, *Artedi.*

Branchiostegals five or six: pseudobranchiæ present. Body oblong, compressed. Snout more or less pointed. Preopercle entire in adults, serrated in the young. Teeth in a single row of conical ones in the jaws, without any posterior canine. A single dorsal fin consisting of many rays, of which 13 *to* 21 *at least are spinous and none are elongated. Anal with three spines and an equal number or less soft rays than in the dorsal. Scales of moderate size, more than forty rows, those on the cheeks and opercles being imbricate: bases of vertical fins scaled: no enlarged row at the base of the caudal fin. Lateral-line continuous.*

Geographical distribution.—Along the shores of Europe, least in numbers to the north. Found at Madeira and adjacent coast of Africa, but most numerous in the Mediterranean.

1. **Labrus maculatus**, Plate LXX and LXXI.

Labrus bergylta, Ascan. Ic. t. i; Bonn. Atl. Ich. p. 115; Shaw, Zool. iv, p. 521; Lacép. iii, pp. 444, 513; Cuv. and Val. xiii, p. 20; Yarrell, Brit. Fish. (Ed. 1) i, p. 275, c. fig. (Ed. 2) i, p. 311 (Ed. 3) i, p. 482; Nilss. Skan. Fauna, iv, p. 261; Kröyer, Dan Fiske, i, p. 476, c. fig.; White Catal. Brit. Fish. p. 20; Collett, Norges Fiske, p. 91, and Christ. Vid. Selsk. Forh. 1879, p. 61; Winther, Ich. Dan. Mar. p. 25; Moreau, Pois. France, iii, p. 81.

Ballan wrasse, Pennant, Brit. Zool. (Ed. 1776) iii, p. 246, pl. xliv (Ed. 1812) iii, p. 334, pl. lv. *The Wrasse*, Low, Faun. Orcad. p. 215.

Labrus maculatus, Bl. vi, p. 17, t. ccxciv; Bl. Schn. p. 250; Fries och Ekstr. Skand. Fisk. p. 43, t. ii; Jenyns, Manual, p. 391; Parnell, Wern. Mem. vii, p. 256, and Fish. Firth of Forth, p. 96; Nilsson, Prod. p. 74; Carlisle, Pro. Zool.

Soc. 1830, p. 17; Dillwyn, Proc. Zool. Soc. 1831, p. 35; Thompson, Proc. Zool. Soc. 1835, p. 81; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 410; Günther, Catal. iv, p. 70; Schlegel, Dieren Neder. p. 18, pl. ii, f. 2; Steind. Ich. Span. u. Port. 1868, p. 27; McIntosh, Fish of N. Uist, Proc. R. Soc. Ed. v, 1862-66, p. 614, and Fish. St. Andrew's, p. 177; Day, Journ. Linn. Soc. Zool. xv, p. 312; Giglioli, Pesc. Ital. p. 34.

Labrus aper, Retz. Faun. Suec. p. 335.

Labrus ballan, Art. Walb. iii, p. 259; Bl. Schn. p. 252; Lacép. iii, pp. 444, 513. Neills. Orkney Islands, p. 43. *Vieille*, Duhamel, Pêches, iii, sect. iv, p. 34, pl. vi, f. 1.

Labrus berg-galt, Müll. Zool. Dan. Prod. p. 46.

Labrus tancoides and *neustriæ*, Lacép. iii, pp. 439, 451, 501, 522.

Labrus tinca, Shaw, Nat. Misc. xi, pl. 426, and Gen. Zool. iv, p. 499, pl. lxxii; Donovan, Brit. Fish. iv, pl. lxxxiii; Turton, Brit. Fauna, p. 98; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 410.

Labrus ballanus, Bonn. Atl. Ich. p. 115, pl. xcviii, f. 400; Shaw, Zool. iv, p. 498, pl. lxxi; Fleming, Brit. An. p. 209 (in part); Templeton, l. c. p. 410.

Labrus lineatus, Turton, Brit. Fauna, p. 99; Flem. Brit. Anim. p. 209; Jenyns, Manual, p. 392; Yarrell, Brit. Fish. (Ed. 1) i. p. 279, c. fig.

Labrus psittacus, Risso, Eur. Merid. iii, p. 304.

Labrus cornubiensis, Couch, Trans. Linn. Soc. xiv, p. 80.

Labrus variabilis, Thompson, Proc. Zool. Soc. 1837, p. 58, and Mag. Nat. Hist. (2) 1839, iii, p. 586, and Nat. Hist. Ireland, iv, p. 120.

Ballan wrass, Couch, Fish. Brit. Isles, iii, p. 24, pl. cxxv.

Young (having a serrated preopercle).

Labrus pusillus, Jenyns, Brit. Vert. p. 392; Yarrell, Brit. Fish. (Ed. 2) i, p. 330, c. fig. (Ed. 3) i, p. 506; Thompson, Nat. Hist. Ireland, iv, p. 130; White, Catal. Brit. Fish. p. 24; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Ed. v, 1862-66, p. 614.

Crenilabrus multidentatus, Thompson, Proc. Zool. Soc. 1837, p. 56, and Mag. Zool. Bot. ii, p. 449, pl. xiii, and Ann. and Mag. Nat. Hist. 1839, ii, p. 418.

Corkling.

Variety 1.—Labrus Donovani,* Plate LXXI, fig. 1.

? Comber, Jago in Rays, Syn. Pisc. p. 163, f. 5.

Comber, Pennant, Brit. Zool. (Ed. 1, 1776) iii, p. 252, pl. xlvii, fig. 122 (Ed. 2) iii, p. 342, pl. lviii.

Labrus comber, Gmel. Linn. p. 1297; Bonn. Atl. Ich. p. 115, pl. xcix, f. 405; Lacép. iii, pp. 453, 523; Shaw, Zool. iv, p. 503; Turton, Brit. Fauna, p. 99; Flem. Brit. An. p. 209; Jenyns, Brit. Vert. p. 393; Yarrell, Brit. Fishes, (Ed. 1) i, p. 289, c. fig. (Ed. 2) i, p. 323 (Ed. 3) i. p. 489; White, Catal. p. 22.

Labrus Donovani (pt.) Cuv. and Val. xiii, p. 39; Günther, Catal. iv, p. 71; Steind Ich. Span. u. Port. 1868, p. 25, t. iv, f. 2.

Comber wrass, Couch, Fish. Brit. Isles, iii, p. 32, pl. cxxvi, f. 2.

In my figure the young is delineated showing the spines and rays of nearly the same height. In Steindachner's beautiful figure of this variety, a little over 9¼ inches in length, the adult stage is being approached, the spines being lower than the rays.

Variety 2.—Labrus lineatus, Plate LXXI, fig. 2 (⅕).

Labrus lineatus, Donovan, Brit. Fishes, iv, pl. lxxiv; Lacép. iii, p. 510; Turton, Brit. Fauna, p. 99; Flem. Brit. An. p. 209; Jenyns, Brit. Vert. p. 392; Nilss. Prod. p. 74.

* Correctly speaking, this variety should perhaps be *Labrus comber*, of Pennant: still, as it is doubtful whether it is Ray's *comber*, I have adhered to the usually received name.

Labrus Donovani (part) Cuv. and Val. l. c.; Yarrell, Brit. Fish. (Ed. 1) i, p. 279, c. fig. (Ed. 2) i, p. 315 (Ed. 3) i, p. 487.

Green wrass or *green-streaked wrass*, Couch, Fish. Brit. Isles, iii, p. 30, pl. cxxvi, f. 1.

Colours green, becoming yellow along the abdomen, and yellow streaks along the rows of scales.

Yarrell in his first edition observes that this fish is the young of the Ballan wrasse.

B. v. D. $\frac{20-21}{9-11}$, P. 14-15, V. 1/5, A. $\frac{3}{8-10}$, C. 14, L. l. 41-47, L. tr. $\frac{6-7}{12-15}$, Vert. 19/19.

Length of head $3\frac{2}{3}$ to 4, of caudal fin $6\frac{1}{4}$ to 7, height of body $3\frac{1}{2}$ to $3\frac{2}{3}$ in the total length. *Eye*—diameter in the adult $5\frac{1}{4}$ to 6, but as large as $4\frac{1}{2}$ in the young, in the length of the head, 2 diameters from the end of the snout, and $1\frac{1}{2}$ to $1\frac{2}{3}$ diameters (1 in the young) apart. The posterior extremity of the maxilla reaches to beneath the front nostril. Lips very thick. The posterior edge of the preopercle smooth in adults, serrated in the young. *Teeth*—in a single row of 7 to 9 in each side of the upper, and 8 to 10 in the lower jaw: palate and tongue smooth. *Fins*—the dorsal commences on a vertical line slightly posterior to the base of the pectoral, its spines are stout and in this as well as in some other species of wrasse, their height in the young nearly or quite equals that of the rays, but in adults the soft portion is considerably higher than the spinous. Pectoral about as long as the head behind the angle of the mouth. Ventral inserted beneath the first third of the pectoral and reaching in the adult rather above half way to the commencement of the anal. Anal commences beneath the last few dorsal spines, its third spine in the adult considerably longer than the second—but in the young only slightly so. Caudal rounded in the young, square or even emarginate in adults. *Scales*—from about nine to eleven rows of small ones across the cheeks: considerably larger on the opercles, while a row extends along each caudal ray. Free portion of the tail at its commencement a little higher than long. *Colours*—these vary exceedingly. Back and sides brownish, blue or green, becoming lighter on the sides and beneath: each scale on the body and head with a blue or nearly white centre: cheeks reticulated with red or orange lines, some of which may be continued on to the chest. Vertical fins yellowish, covered with orange or yellow rings: pectoral yellow, with a light band having a dark base; outer half of fin darker than the remainder. The next most common form of colour that I have seen has been green with narrow longitudinal bands of yellow (*L. lineatus*): this may be without spots, with a dark mark behind the base of the soft dorsal fin, or it may have numerous red spots on the body and fins. A not uncommon colour is pale yellow, and one 12 inches long had three rows of small blue spots along the spinous dorsal fin, and five along the soft portion, the anal being similarly marked. In others a white band may pass from the snout through the eye to the tail as in the comber; while its remaining colours may be exceedingly various. In fact, there are few combinations of colours that this fish cannot take, and which induced Thompson to suggest that *Labrus variabilis* would be its most appropriate name.

Varieties.—In form.—These are mostly due to differences in the number and comparative height of the spines and rays of the fins, which have been already referred to: serrations along the posterior border of the preopercle are generally diagnostic signs of the immaturity of the specimen; while the head is comparatively longer in the immature than in the adult. *In colour.—L. lineatus* was first mentioned by Pennant, who observed on having seen one taken at the Giants' Causeway, in Ireland, of a vivid green spotted with scarlet (*Perroquet de mer*, French), and at Sligo one of a pale green (*Vieille vert*, French). Donovan next figured it, the body being green with numerous yellowish longitudinal lines (*Vieille jaune*, French); while on July 29th, 1881, I obtained one at Penzance of a general bright emerald green covered with white spots, the head and fins as in

the normal form but the vertical fins having blue spots. The *comber* has a white lateral band along the body from the eye to the base of the caudal fin.

Names.—*Bergle*, Orkneys: *Ballan-wrasse*, *sea-swine*, Moray Firth, owing to its making a squeaking noise like a pig. *John-rúa*, Cornwall (Cornish): *Old* or *ancient wife*, *old ewe*, *servellan wrasse*, and *sweet lips* (Yorkshire Vertebrata): or *rath raagh*, Cornwall: *Gwrach*, "old woman," Welsh.

In Ireland, *bavin* on the north-east coast: *morrian* and *murranroe* near the Giants' Causeway: *gregagh* in the north. *La vieille commune*, French. *De lipvisch*, Dutch.

Habits.—It resides in moderately deep water on a rocky shore, and prefers the vicinity of sea-weed into which it retreats on being alarmed. At Lossiemouth, Moray Firth, it is found most frequently during the summer months in company with the Saithes, *Gadus virens*. But it has been observed that these wrasses when of certain sizes, and, therefore, it may be presumed ages, associate together, the largest forms not permitting the smaller ones to intrude. It eats shrimp-like crustacea, worms, and even limpets. Thompson remarks that near Holywood, during an easterly gale in February, 1838, numbers, perhaps five hundred, and no other fish, were thrown up dead on the shore.

Means of capture.—Will take a bait very readily, which it gorges. Buckland observed that during the month of September it gives excellent sport as follows: Take a long piece of string, unravel about a couple of yards of the end, so that there is a single strand only. To this tie a common beach pebble, attach the hooks to the string, so that when in the water they shall stand at right angles to it. Coil up the string neatly on to the rock; swing the stone round three or four times, let it go suddenly, and it will carry the string, hooks, and all well in among the rocks and weed. When you have a bite, strike smartly. As you are fishing among rocks, the probability is that the stone will get jammed; pull smartly, and break the single strand, leaving the stone in the sea.

In Galway, Mr. McCalla says, this fish is a favourite food, and fished for as follows:—A spot is selected near a sunken rock, sometimes as much as twelve miles out at sea, where there is a foul bottom and often thirty fathoms of water: here a stone is used as an anchor and a pebble to sink the line with, and which is only loosely attached in order that it may drop off should it stick in the fissure of a rock. For this occupation the day time is invariably chosen and fine weather. According to Couch, Cornish fishermen remark that when they first fish a place, they take but few, and those of large size: but on trying the same spot a few days subsequently, they catch a greater number, and those smaller; from which circumstance they conclude that the large fish assume the dominion of a district and keep the smaller ones at a distance.

Baits.—Worms or a soft crab being one which has lately left his shell, or shell-fish, or even sea-weed.

Breeding.—In Galway about June, along the south coast from May until July. Parnell found one taken at Hopetown in August full of spawn ready for depositing: while along Cornwall Couch found it to breed in April. M. Moreau (iii, p. 102) observes that this species, and likewise the *L. mixtus*, form nests for the reception of their eggs (as described at page 257).

Diseases.—R. Couch saw one taken, which weighed $4\frac{1}{4}$ lb. and was blind in both eyes from, he thought, cataract: he also observed that old ones are very liable to loose their sight due to opacity of the cornea. They are much infested with *Lernea*.

As food.—Generally not much esteemed, but according to Low is much prized in the Orkneys, although it is sometimes coarse and thick-skinned: it is roasted fresh, and seldom or never salted. We are told that it forms a favourite dish in Galway, but is little prized in Belfast. Parnell observes that it is occasionally brought to the Edinburgh market for sale, but is not sought after as its flesh is white, soft, and very insipid.

Uses.—Bait for crab or lobster pots.

Habitat.—From the coasts of Scandinavia, Denmark, and the European shores

of the North Atlantic to the Mediterranean, where it decreases in numbers as we proceed towards the east.

In the Orkneys found close in shore where the cliffs are high and the water deep (Low), but it is not common in Orkneys and Zetland (W. Baikie): pretty frequent during summer off Banffshire (Edward): St. Andrew's (McIntosh): Firth of Forth rare (Parnell), but occasional in North Berwick. Thompson recorded this species from Ayrshire and Wigton, and McIntosh from North Uist, while he likewise observes that it is occasionally brought from deep waters at St. Andrew's, while many young are seen during autumn in the rock pools.

In Yorkshire resident and abundant (Yorkshire Vertebrata): sometimes appearing during the summer in great shoals off Filey Bridge (Pennant): a few taken at Flamborough in October (J. Cordeaux, Zool. 1868, p. 1027): a green variety in the Wisbeach Museum was taken in the Norfolk estuary, and another by Mr. Cresswell off Hunstanton. These wrasses have also been recorded from Lynn Roads, November 14th, 1869 (E. King), Yarmouth, April 15th, 1868 (Gunn), and likewise some young about 8 inches in length captured by a hook and line in the outer harbour of Lowestoft, in August, 1852. Margate, in February, 1870 (H. Lee). The example recorded by Lester (Zool. 1855, xiii, p. 4913), dredged in Swanage Bay, was evidently a small comber.

In Weymouth abundant, brilliant specimens and some of large size occur frequently in various parts of the bay (P. Gosse): examples from Plymouth have been received at the British Museum, while it is very common along the Cornish coast. Skerry Isles, north of Anglesea (Donovan): Swansea Bay (L. Dillwyn).

In Ireland the most common form and found all round the coast where it is of a rocky character: numerous in Down and Antrim: at Donaghadee it is abundant attaining to as much as 8 lb. in weight, but it is little prized as food.

The example from which plate lxx was figured is $15\frac{1}{4}$ inches long and came from Brixham: No. 1 on plate lxxi was brought from Guernsey by Mr. Carrington and given to me, it is figured life size: while No. 2 is from an example $16\frac{1}{2}$ inches long, taken at Grimsby in May, 1881. I have not obtained larger specimens.

2. Labrus mixtus, Plate LXXII, fig. 1 *male*, fig. 2 *female*.

Labrus mixtus, Fries och Ekstrom, Skand. Fisk. p. 160, pl. xxxvii and xxxviii (*Labrus dispar*); Nilss. Skand. Faun. iv, pp. 265, 278; White Catal. Brit. Fishes, p. 21; Günther, Catal. iv, p. 74; Roper, An. and Mag. N. Hist. (4), 1869, iv, p. 294; Steind. Ich. Span. u. Port. 1868, p. 23; Collett, Norges Fiske, p. 91, and Christ. Vid. Selsk. Forh. 1879, p. 61; Winther, Ich. Dan. Mar. 1879, p. 26; Giglioli, Pesc. Ital. p. 34.

Synonymy of Males.

Turdus perbelle pictus and *Turdus major varius*, Willughby, p. 322, t. X3. *Labrus*, no. 3 and no. 4 Artedi, Genera, p. 34. *Blastaal*, Ström. Söndm. i, p. 269. *Striped wrasse*, Pennant's Brit. Zool. (Ed. 1) iii, p. 249, pl. xlv, and (Ed. 1812) iii, p. 337, pl. lvii. *Cook*, Penn. l. c. (Ed. 1766) iii, p. 253, and (Ed. 1812) iii, p. 340. *Coquus*, Ray, Syn. Pisc. p. 163, f. 4.

Labrus mixtus, Linn. Syst. Nat. i, p. 479; Lacép. iii, p. 436; Artedi, Gen. p. 34, Syn. 57; Shaw, Zool. iv, p. 507; Gmel. Linn. p. 1297; Risso, Ich. Nice, p. 222, and Eur. Mérid. iii, p. 308: Cuv. and Val. xiii, p. 43; Yarrell, Brit. Fishes (Ed. 2) i, p. 317, c. fig. (Ed. 3) i, p. 491; Moreau, Poiss. France, iii, p. 96.

? Labrus ossiphagus, Linn. Syst. Nat. i, p. 478; Bl. Schn. p. 268; Lacép. iii, p. 440.

Labrus cœruleus, Ascan. Ic. pl. xii.

Labrus variegatus, Gmel. Linn. i, p. 1294; Lacép. iii, pp. 442, 508; Donovan, Brit. Fish. i, pl. xxi; Shaw, Zool. iv, p. 501, pl. lxxi; Turton, Brit. Fauna, p. 99; Risso, Ich. Nice, p. 229; Jenyns, Manual, p. 394; Yarrell, Brit. Fishes (Ed. 1) i, p. 281, c. fig.; Thompson, Proc. Zool. Soc. 1835, p. 81, and Nat. Hist. Ireland, iv, p. 124; Templeton, Mag. Nat. Hist. (2) 1837, i, p. 410.

Labrus coquus (cook), Gmel. Linn. p. 1297; Art. Walb. iii, p. 260; Shaw, Zool. iv, p. 503; Lacép. iii, p. 443; Turton, Brit. Fauna, p. 99; Flem. Brit. Anim. p. 209; Jenyns, Man. p. 396.

Labrus vittatus, Art. Walb. iii, p. 256.

Labrus vetula, Bl. t. ccxciii; Bl. Schn. p. 250; Lacép. iii, p. 447; Swainson, Fishes, ii, p. 228; Yarrell, Brit. Fishes (Ed. 1) i, p. 284, c. fig.; Jenyns, Man. p. 395.

Grammistes variegatus, Bl. Schn. p. 190.

Sparus formosus, Shaw, Nat. Misc. i, pl. xxxi.

Labrus formosus, Shaw, Zool. iv, p. 512.

Labrus pavo, Risso, Eur. Mérid. iii, p. 299 (not Ich. Nice).

Labrus lineatus, Bonn. Atl. Ich. p. 113, pl. xcviii, f. 402; Risso, Ich. Nice, p. 220.

Labrus larvatus, Rafin. Caratt. 38, sp. 101; Lowe, Proc. Zool. Soc. 1850, p. 249.

Striped wrasse, cook or *cuckoo wrass*, Couch, Fish. Brit. Isles, iii, p. 34, pl. cxxvii.

Synonymy of females.

Labrus carneus, Ascan. Ic. t. xiii; Bloch, t. cclxxxix; Bl. Schn. p. 249; Yarrell, Brit. Fishes (Ed. 1) i, p. 286, c. fig; Nilss. Prod. p. 75; Parnell, Wern. Mem. vii, p. 258, and Fish. Firth of Forth, p. 98.

Trimaculated wrasse, Pennant, Brit. Zool. (Ed. 1776) iii, p. 248 (Ed. 1812) iii, p. 336.

Labrus trimaculatus, Gmel. Linn. i, p. 1294; Bonn. Atl. Ich. p. 113, pl. xcviii, f. 401; Lacép. iii, pp. 435, 488; Shaw, Nat. Misc. xix, pl. 786, and Zool. iv, p. 502; Donovan, Brit. Fish. iii, pl. xlix; Turton, Brit. Fauna, p. 99; Risso, Ich. Nice, p. 219; Cuv. and Val. xiii, p. 58; Jenyns, Manual, p. 396; Thompson, Nat. Hist. Ireland, iv, p. 126; Yarrell, Brit. Fish. (Ed. 2) i, p. 320 (Ed. 3) i, p. 495; Guichen, Explor. Alger. Poiss. p. 83.

Labrus exoletus, Retz. Faun. Suec. p. 335.

Labrus mixtus, Kröyer, Dan. Fiske, i, p. 496, c. fig.

Three-spotted wrass, Couch, Fish. Brit. Isles, iii, p. 36, pl. cxxvii.

Yarrell in his third edition of British Fishes observes that this is the female of *L. mixtus*.

Varieties of female.

Labrus bimaculatus, Linn. Syst. Nat. i, p. 477; Gmel. Linn. p. 1289; Bonn. Atl. Ich. p. 112; Lacép. iii, p. 439; Bl. Schn. p. 261; Shaw, Zool. iv, p. 502; Risso, Ich. Nice, p. 227; Turton, Brit. Fauna, p. 99; Jenyns, Manual, p. 396.

Bimaculated wrasse, Pennant, Brit. Zool. (Ed. 1776) iii, p. 247 (Ed. 1812) iii, p. 355.

Labrus quadrimaculatus, Risso, Eur. Mérid. iii, p. 302.

(*Monstrosity.*)

Labrus vetula, Yarrell, Brit. Fish. (Ed. 1) i, p. 284, c. fig.; Jenyns, Manual, p. 395 (not Bloch).

Acantholabrus Yarrellii, Cuv. and Val. xiii, p. 259; Yarrell, Brit. Fish. (Ed. 2) i, p. 339 (Ed. 3) i, p. 516; White, Catal. p. 25.

Sea-wife, Couch, Fish. Brit. Isles, iii, p. 37.

Nilsson (iv, p. 273) first suggested that this fish was a monstrosity of *L. mixtus* in which three of the soft rays had become transformed into spines. The type appears to have been lost.

B. v, D. $\frac{16\text{-}18}{(11)12\text{-}14}$, P. 17, V. 1/5, A. $\frac{3}{10\text{-}12}$, C. 13-15, L. l. 50-60, L. tr. 5-7/17-21, Vert. 18/21.

Length of head $3\frac{1}{2}$ to $3\frac{2}{3}$, of caudal fin $7\frac{1}{4}$ to 8, height of body $4\frac{1}{4}$ to $4\frac{2}{3}$ in the total length. *Eye*—diameter $5\frac{1}{2}$ in the length of the head, 2 to $2\frac{1}{4}$ diameters from the end of the snout, and $1\frac{1}{4}$ apart. Body rather compressed, snout

elongated: lips very thick. Bones of the head unarmed. The posterior extremity of the maxilla does not reach so far as to beneath the front edge of the eye. Posterior edge of preopercle smooth or even crenulated, very distinctly so in a female example 11 inches in length, and serrated in its lower half in a male $7\frac{1}{2}$ inches long. *Teeth*—conical, in a single row, 7 to 13 in either side of the upper and 9 to 21 in the lower jaw, the largest being anteriorly. *Fins*—dorsal commences above the base of the pectoral, its spines gradually increase in length to the last which equals the height of the soft rays. Pectoral half as long as the head. Ventral commencing beneath the middle of the pectoral reaches more than half way to the anal. Caudal rounded. *Scales*—about 7 rows across the cheeks: present also on opercles, and a row along each caudal ray. *Lateral-line*—curves gradually to beneath the posterior end of the soft dorsal, where it becomes straight. The tubes simple. *Colours*—these differ widely in the sexes, and are also subject to great variations. *Male*—general colour of the body yellow or orange tinged with red, becoming lightest beneath: five or six bands of blue radiate backwards from the eye, one being generally continued along the body below the lateral-line to the caudal fin, while a similar, but less marked, blue band exists above the lateral-line. Fins yellow or orange, a large blue blotch occupies most of the interspinous membrane existing between the first twelve dorsal spines and is sometimes continued backwards in the form of spots as far as the first ray. A narrow blue band with an outer white edging passes along the dorsal and anal fins: while the outer half or two-thirds of the caudal is likewise blue. Occasionally the blue edging to the anal is very wide. *Female*—yellow or orange-red along the back becoming lighter on the sides and beneath. Fins yellow or orange, a purplish or bluish blotch occupies most of the interspinous membrane existing between the first three or four dorsal spines: two black blotches, surrounded by a light margin, are present on the back beneath the soft dorsal fin on to which they are usually extended, a third similar one is present over the free portion of the tail. The fins, except the caudal, frequently edged as described for the male. The light margin surrounding the black blotches are sometimes expanded into distinct light round or oval marks. The young males are similarly coloured to the females.

Varieties.—*Labrus vetula*, Yarrell (not Bloch), has, as already observed, been pointed out by Nilsson to be an abnormal example.

Fries and Ekström first discriminated that the blue-striped wrasse is the male and the three-spotted wrasse the female of one species.

Fleming placed *L. bimaculatus* and *trimaculatus* as varieties of *L. maculatus*, while he admitted *L. coquus* as a distinct species. Couch remarks of the female that he has seen it with from three to five black spots on the back and dorsal fin. I obtained one with only a single black blotch on the dorsal fin. Some fishermen consider that a predominance of yellow denotes that the example has been residing in deep waters.

Names.—*Cook wrasse*, *blue-striped wrasse*, *cook-conner*. *Cuckoo-fish*, Cornwall. *Livery-servant* and *livery-fish* in the north of Ireland. *Female*—*red wrasse*, *flesh-coloured wrasse*, *two-* or *three-spotted wrasse*. *Le labre mêlé* ou *varie*, French.

Habits.—It inhabits rocky shores but does not appear to like sandy bays. It feeds on mollusca and crustacea, coming nearer in shore during the summer months. It is especially partial to the spider crab, and is frequently taken in crab-pots.

Means of capture.—Takes a bait freely, especially those being employed whiffing for pollack.

Baits.—Lob-worms.

Breeding.—Deposits its spawn in April or May, and R. Couch found examples with ova in July and August, but he thought the same fish does not breed twice in one season, since the April and August breeders are rarely found in the same locality. Risso on the contrary considered that it bred at two separate seasons. Thompson observes that its ova are extremely minute.

Hermaphrodites.—Couch remarked upon having obtained one of this species in the month of May.

As food.—Couch asserts that in Cornwall it is rarely used for this purpose.

Habitat.—From the coasts of Scandinavia, Denmark, and the European shores of the German Ocean and North Atlantic, throughout the Mediterranean, where it is common.

At Kirkwall in the Orkneys once (Iverach): five males were taken at Wick in Caithness in June, 1870, in one day on haddock lines: the fishermen asserted they were entirely new to them (Reed). Banffshire rare; a very pretty specimen was taken off Macduff (Edward); October 26th, 1853, two examples were captured in the Moray Firth on a small haddock line set in 14 to 18 fathoms water, on very rough ground; one was 10 the other 11 inches in length (G. Gordon, Zool. p. 4171). Firth of Forth, according to Neill, but Parnell never saw it there. At North Uist it is found in shoals at the margins of the rocks, or lurking under sea-weeds in rock pools (McIntosh). In Yorkshire Mr. Cordeaux remembers seeing an example some years ago on the coast, he thinks, at Flamborough (Yorkshire Vertebrata); in 1869 its capture was recorded from Eastbourne (Roper, Ann. and Mag. (4) iv, p. 294); September 27th, 1858, an example of *L. carneus*, Bloch, was taken at Weymouth with shrimps for a bait, and one in October, 1853 (Gosse). Specimens have been received at the British Museum from Plymouth. Common along the coasts of Devonshire and Cornwall, while at the Land's End it abounds, but keeps to deeper water than *L. maculatus*, preferring rough and rocky ground. Leach obtained it from Swansea, Pennant from Anglesea.

Ireland.—It is occasionally but rarely taken round the island. Coasts of Antrim and Down; Dublin; Ardmore in county of Waterford; Youghal in Cork and Kilkee (Ball); Galway (M'Calla).

The largest example I have obtained along the south coast, where it is plentiful, is 13 inches in length.

Genus II.—Crenilabrus, *Cuvier.*

Coricus, Cuvier; *Cynœdus*, sp. Swainson.

Branchiostegals five or six: pseudobranchiæ present. Body oblong and compressed. Preopercle serrated. Teeth in the jaws conical and in a single row without any posterior canine: palate edentulous. A single dorsal fin consisting of upwards of 20 *rays, of which from* 13 *to* 18 *at least are spinous, and none are elongated: anal with three spines. Scales of moderate size but not so many as forty rows: those on the cheeks and opercles being imbricate. Lateral-line continuous.*

A rather weighty objection exists to this genus, in that many of the young of genus *Labrus* have the preopercle serrated, while in some of *Crenilabri* the preopercle loses its serrature, so that they are similar to *Labrus*. Bleeker, however, pointed out that no examples of this genus have so many as 40 rows of scales along the lateral-line, whereas all of *Labrus* have more that 40. Until the intermediate forms are recognized perhaps the validity of the genus may be admitted. Bleeker restricted *Coricus* to some species, in which the snout is produced.

Geographical distribution.—Similar to that observed in the genus *Labrus*.

M. Gerbe (Rev. et Mag. Zool. xvi, pp. 255, 273, 337) has recorded how species of this genus, *C. massa* and *C. melops*, form nests of sea-weed, shells, and other substances in which the ova are deposited: both sexes engage in their construction. *C. pavo* acts similarly (Moreau, l. c.), as do also species of the genus *Labrus* (see page 255).

1. **Crenilabrus melops,** Plate LXXIII.

Bergylte, Ström. Söndm, p. 266, No. 1, 2.

Labrus melops, Linn. Mus. Ad. Frid. ii, p. 78, and Syst. Nat. i, p. 477; Bonn. Atl. Ich. p. 112; Shaw, Zool. iv, p. 505; Bl. Schn. p. 261; Lacép. iii, p. 435; Fries och Ekstr. Skand. Fisk. p. 182, pl. xliv.

Labrus turdus, Müll. Prod. no. 383.

Lutjanus melops, Risso, Ich. Nice, p. 265.

Crenilabrus melops, Cuv. Règ. Anim.; Risso, Europ. Mérid. iii, p. 318; Cuv. and Val. xiii, p. 167; Yarrell, Brit. Fish. (Ed. 2) i, p. 325, c. fig. (Ed. 3) i, p. 498; Guichen. Expl. Algér. Poiss. p. 85; Kröyer, Dan. Fiske, i, p. 521, c. fig.; Nilss. Sk. Faun. iv, p. 270; White, Catal. p. 23; Günther, Catal. iv, p. 80; Steind. Ich. Span. u. Port. 1868, p. 30; Collett, Norges Fisk. p. 92; McIntosh, Fish. St. Andrew's, p. 177; Winther, Ich. Dan. Mar. p. 26; Giglioli, Pesc. Ital. p. 34; Moreau, Poiss. France, iii, p. 111.

Labrus tinca, Turton, Brit. Fauna, p. 98; Jenyns, Manual, p. 397.

Crenilabrus tinca, Yarrell, Brit. Fish. (Ed. 1) i, p. 293; Thompson, Mag. Zool. Bot. ii, p. 442, Proc. Zool. Soc. 1837, p. 59, and Nat. Hist. Ireland, iv, p. 126; Parnell, Fish. Firth of Forth, p. 99, and Wern. Mem. vii, p. 259.

Cynœdus tinca, Swainson, Fishes, ii, p. 229.

Baillon's wrass, Couch, Fish. Brit. Isles, iii, p. 45, pl. cxxxii (not Cuv. and Val.).

Variety I. Crenilabrus rone.

Labrus rone, Ascan. Ic. t. xiv; Bonn. Atl. Ich. p. 111; Lacép. iii, p. 437; Nilss. Prod. p. 77.

Crenilabrus rone, Cuv. and Val. xiii, p. 172.

This variety has no black spot behind the eye. Back reddish with green spots; abdomen silvery with red spots. Three red bands along the soft and two along the spinous dorsal fin: anal similar to soft dorsal.

Variety 2. Crenilabrus Pennantii.

Goldsinny, Pennant, Brit. Zool. (Ed. 1776) iii, p. 251, pl. xlvii (Ed. 1812) iii, p. 339, pl. lviii.

Labrus goldfinny, Bonn. Atl. Ich. p. 112, pl. xcix, f. 404.

Crenilabrus Pennantii, Cuv. and Val. xiii, p. 178.

Black spot at base of tail small: one at vent, another behind the eye. Well-marked bands of colour across cheek and snout.

Variety 3. Crenilabrus Norwegicus.

Lutjanus Norwegicus, Bloch, t. cclvi; Lacép. iv, pp. 190, 232, 234.

Perca maculosa, Retz. Faun. Suec. p. 337.

Labrus Norwegicus, Bl. Schn. p. 254; Nilss. Prod. p. 26.

Crenilabrus Norwegicus, Cuv. and Val. xiii, p. 176; Yarrell, Brit. Fish. (Ed. 2) i, p. 328, c. fig.

A well marked black spot at the base of the caudal fin, none behind the eye. Body, dorsal and caudal fins marbled with brown: some bands from eye to upper lip and angle of the mouth.

Variety 4 Crenilabrus Cornubicus.

Labrus Cornubicus, Gmel. Linn. i, p. 1297; Lacép. iii, p. 436 (*sc. Cornubius*); Donov. Brit. Fish. iii, pl. lxxii; Turton, Brit. Fauna, p. 99; Jenyns, Manual, p. 398.

Crenilabrus Cornubicus, Risso, Ich. Nice, p. 267, and Eur. Mérid. iii, p. 325; Yarrell, Brit. Fish. (Ed. 1) i, p. 296, c. fig. (Ed. 3) i, p. 504; Parnell, Fish. Firth of Forth, p. 102, and Wern. Mem. vii, p. 262; Thompson, P. Z. S. 1835, p. 81.

Labrus Donovani, Cuv. and Val. xiii, p. 180; Guichen. l. c. p. 86.

Cynædus Cornubicus, Swainson, Fishes, ii, p. 229.

Goldsinny. Body greenish brown, becoming yellow below. About six vertical bands on the body, some of which extend on to the fins: a large dark spot at the base of the caudal fin.

Variety 5. Crenilabrus Couchii.

Corkwing, Couch, Mag. Nat. Hist. v, p. 17, f. 4, and Fish. Brit. Isles, iii, p. 43, pl. cxxxi.

Crenilabrus Couchii, Cuv. and Val. xiii, p. 178.

A deep black spot at the base of the tail; a lighter one behind the eye. Numerous stripes of red or green on the head and also on the vertical fins.

Monstrosities.

Gibbous wrasse, Pennant, Brit. Zool. (Ed. 1776) iii, p. 250, pl. xlvi (Ed. 1812) iii, p. 338, pl. lvi.

Labrus gibbus, Gmel. Linn. i, p. 1295; Bonn. Atl. Ich. p. 112, pl. xcix, f. 403; Bl. Schn. p. 261; Lacép. iv, p. 219; Turton, p. 98; Jenyns, p. 399.

Crenilabrus gibbus, Fleming, p. 209; Cuv. and Val. xiii, p. 175; Yarrell, Brit. Fish. (Ed. 1) i, p. 298, c. fig.

Cynœdus gibbus, Swainson, Fishes, ii, p. 229.

Pennant's example, eight inches long, came from Anglesea.

B. v, D. $\frac{14-17}{8-9}$, P. 14, V. 1/5, A. $\frac{3}{9-10}$, C. 14, L. l. 32-35, L. tr. 4/12, Vert. 15/18.

Length of head 4 to $4\frac{1}{4}$, of caudal fin $5\frac{1}{2}$ to $6\frac{1}{2}$, height of body $3\frac{1}{4}$ to $3\frac{1}{2}$ in the total length. *Eye*—diameter $4\frac{1}{2}$ in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and 1 to $1\frac{1}{2}$ apart. Hind edge of preopercle evenly serrated. The posterior extremity of the maxilla does not reach to beneath the orbit. *Teeth*—conical, and in a single row in either jaw. *Fins*—dorsal spines of moderate strength, gradually increasing in height to the last; soft portion of the fin a little higher than the last spine and rounded. Third anal spine the longest. Caudal rounded, or nearly square. *Scales*—5 to 6 rows on the cheeks below the eyes: opercles scaled. *Lateral-line*—curves downwards beneath the last few dorsal rays. *Colours*—these vary exceedingly, being reddish or purplish-brown along the back, greenish-yellow on the sides, and light beneath. In well-marked examples about eight vertical dark brown bands descend from the back, the posterior eight of which are continued to the abdomen, and close to the base of the caudal fin on or below the lateral-line, is a dark spot. Usually these bands on the body are broken up and appear as irregular blotches. A dark band surrounds the lips, and one portion is continued backwards to the centre of the front of the eye, while another passes along the under edge of the eye to its posterior margin, where it forms a dark spot. Three or four yellow, red, or green bands cross the cheeks and opercles. The markings on the vertical fins are very various, three or four of the body bands may be continued on to the dorsal fin, and two or three on to the anal, where they join, forming arches. Or two dark bands may pass along the spinous dorsal, and rings of red or yellow with dark centres may be present on the soft portion: the caudal being similarly coloured. The anal may be marked as the soft dorsal, or have two or three rows of dark round spots. Pectoral with a dark band at its base, and two or three light ones across it.

Varieties.—The height of the body in this species, as compared with its length, is subject to very great differences. The colours, as already observed, differ very widely, and any of those adverted to, may be variously disposed in different individuals. The spot at the base of the caudal fin, also that behind the eye, may be entirely absent.

Couch introduces Baillon's wrass, *C. Baillonii*, c. v, into his History of British Fishes, on the strength of an example $7\frac{1}{4}$ inches in length. He observed that he did so "with some degree of hesitation; but a drawing of one which came a few years since into my possession" came so near to a description of Baillon's wrass that he inserted it. I received from Mr. Carrington, F.L.S., in 1879, a beautiful example of *C. melops*, which, having been kept some time in spirit, lost nearly all its markings, and became similar to Couch's figure, pl. cxxxii. But it has five rows of scales across the cheeks below the eye, not three as found in *C. Baillonii*.

Names.—*Sea-partridge*, Moray Firth; *the conner*, *gilt-head*, or *golden-maid*. *Le Crénilabre mélope*, French.

Habits.—Gregarious, and is usually found in shallower water than most of the other forms of wrasses. It has been taken in rock pools, but Parnell observed in the Firth of Forth that it often frequented deep and rocky recesses in preference to more open and sandy situations. It feeds on crustacea and animal substances, on small shells, and even vegetable matter.

Means of capture.—Takes a bait readily, especially a bit of mussel; but Parnell observed that in the Firth of Forth it is hardly ever secured by a hook, but mostly found in crab cages and lobster pots.

Breeding.—"April and May, and in June, July, and August; the young, of a bright green colour, may be taken in pools with a shrimp net" (R. Couch).

Uses.—As bait for crabs and lobsters.

As food.—Is not eaten. Parnell found that the flesh when boiled had a bluish-white appearance, and a very disagreeable tarry flavour.

Habitat.—It has been observed in Norway to the 62° of N. latitude; it extends along the coast of Denmark and the German Ocean, also the European shores of the Atlantic to the Mediterranean, becoming rarer towards the east. Orkneys and Zetland rare (W. Baikie); Banff rare (Edward); St. Andrew's not common (McIntosh); Moray Firth often met with (Martin); Firth of Forth occasional, while on the rocky coasts of Preston-pans, North Berwick, Largo, and Burntisland it is not infrequently taken (Parnell). Mr. Cordeaux considers he has seen it at Flamborough, though unsuccessful in his attempts to capture it (Yorkshire Vertebrata). Weymouth abundant around the quays in summer and autumn (P. Gosse); Devonshire (Montagu): very common in Cornwall, frequenting rocks close in shore among the sea-weeds; and the most abundant form on the west coast (Couch). Donovan obtained it from off the Lizard. It has likewise been captured off Somersetshire.

In Ireland it is found round the coast, and next in frequency among the *Labridæ* to the Ballan, *Labrus maculatus.*

It seldom exceeds nine inches in length. The example figured (natural size) was obtained at Brighton, it had the vertical bands on the body much more distinctly marked than is usually the case, while the colours on the fins were very vivid.

Genus III.—Ctenolabrus, *Cuvier and Valenciennes.*

Branchiostegals five: pseudobranchiæ present. Body oblong and compressed. Teeth in the jaws in a band of conical ones, the outer row being the larger: no posterior canine. A single dorsal fin consisting of upwards of 20 *rays,* 16 *to* 18 *at least of which are spinous, and none are elongated: anal spines three. Scales of moderate size, those on the cheeks and opercles being imbricate. Lateral-line continuous.*

This genus has been subdivided into two subgenera as follows:

1. Interoperculum scaled. European. *Ctenolabrus.*
3. Interoperculum scaleless. American. *Tautogolabrus.*

Geographical distribution.—The temperate portions of the North Atlantic Ocean, both in Europe and America; likewise found in the North Sea and Mediterranean.

1. Ctenolabrus rupestris, Plate LXXIV.

Goldsinny, Ray, Syn. Pisc. p. 163, t. i, f. 3; *Karudsee*, Sondm. i, p. 291; *Bergnultra*, Linn. West. Resa, p. 179. *? Antient wrasse*, Pennant, Brit. Zool. (Ed. 1) iii, p. 244, pl. xlvii, fig. 115, and (Ed. 2) iii, p. 332, pl. lviii.

Sciæna rupestris, Linn. Mus. Ad. Frid. p. 65, t. xxi, f. 7.

Labrus suillus, Linn. Faun. Suec. p. 117, and Syst. Nat. i, p. 476.

Labrus rupestris, Linn. Syst. Nat. i, p. 478; Walb. Artedi, iii, p. 252; Bonn. Atl. Ich. p. 112; Müll. Prod. Zool. Dan. p. 45; Bl. Schn. p. 248; Nilss. Prod. p. 76; Fries and Ekst. Skand. Fish. p. 45, t. ix, f. 1; Risso, Eur. Mérid. iii, p. 507; Johnston, Fish. Berwickshire N. F. Club, 1838, i, p. 172.

Perca rupestris, Müller, Zool. Dan. iii, p. 44, t. cvii; Retz. Faun. Suec. p. 337.

Lutjanus rupestris, Bloch, t. ccl, f. 1.

Sparus carudse, Lacép. iv, p. 148.

Crenilabrus rupestris, Selby, Mag. Zool. Bot. i, p. 167; Thompson, l. c. ii, p. 445, Proc. Zool. Soc. 1837, p. 57, and Nat. Hist. Ireland, iv, p. 129; Parnell, Wern. Mem. vii, p. 264, and Fish. Firth of Forth, p. 104; Yarrell, Brit. Fishes (Ed. 2) i, p. 333, c. fig.; Kröyer, Dan. Fiske, i, p. 541, c. fig.; Blake-Knox, Zool. Dec. 1866, p. 506; White, Catal. p. 24.

Ctenolabrus rupestris, Cuv. and Val. xiii, p. 223; Yarrell, Brit. Fish. (Ed. 3) i, p. 509; Nilss. Skan. Faun. Fisk. p. 274; Guichen. Explor. Algér. Poiss. p. 88; Günther, Catal. iv, p. 89; McIntosh, Fish. N. Uist. Pro. Roy. Soc. Edin. v, 1862-66, p. 614; Steind. Ich. Span. u. Port. 1868, p. 32; Collett, Norges Fisk. p. 92; Winther, Ich. Dan. Mar. p. 26; Moreau, Poiss. France, iii, p. 134, c. fig.; Giglioli, Pesc. Ital. p. 35.

Ctenolabrus marginatus, Cuv. and Val. xiii, p. 232; Günther, Catal. iv, p. 89.

Cynœdus rupestris, Swainson, Fishes, ii, p. 229.

Jago's goldsinny, Couch, Fish. Brit. Isles, iii, p. 47, pl. cxxxiii.

B. v, D. $\frac{16-18}{8-10}$, P. 14, V. 1/5, A. $\frac{3}{8}$, C. 15, L. l. 38-40, L. tr. $\frac{3-4}{14-15}$, Vert. 15/18.

Length of head 4 to $4\frac{2}{3}$, of caudal fin $7\frac{1}{2}$, height of body $3\frac{1}{2}$ to $3\frac{3}{4}$ in the total length. *Eye*—diameter $3\frac{1}{3}$ to 4 in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 1 apart. Snout rather pointed. Mouth rather small: jaws even anteriorly: the posterior extremity of the maxilla scarcely reaches to beneath the front edge of the eye. Posterior border of preopercle evenly serrated. *Teeth*—a band of conical ones in the jaws, the outer row being the larger. *Fins*—the dorsal commences slightly posterior to the origin of the pectoral; its spines increase in height to the last, which, however, is lower than the rays: soft portion of the fin rounded and similar to the anal. Pectoral

inserted below the middle of the height of the body, and more than half as long as the head. Third anal spine the longest. Caudal square or slightly rounded at its extremity. *Scales*—six rows across the cheeks, some very minute ones on the vertical fins, and a row between each caudal ray. *Colours*—variable, usually of a pinkish or golden hue, darkest along the back. Fins reddish, the dorsal with a black blotch on its commencement, extending from the first to the sixth spines; while there is another at the upper part of the base of the caudal fin. In some there are several broad, dark vertical bands on the body; in others a light band runs half way along the side as shown in the figure on plate lxxiv. While there may be a dark spot with a reddish tinge in the axilla of the pectoral fin.

Pennant's *Antient wrasse* is said to have D. 19/9, A. 3/9, and the teeth in two rows. Parnell and some others referred it to *Crenilabrus melops.*

Varieties.—For examples having narrow black edges to the vertical fins, the term *C. marginatus* has been given.

Names.—Pink brame, two-spot brame, and *poisoned brame,* Dublin. *Le Cténolabre des roches,* French.

Habits.—Does not frequent tidal harbours, but appears to keep to deep water. This is one of the forms which has been observed to sleep at night time (Mobius, Zool. Gart. 1867, p. 148, and Hughes, Zool. 1874, p. 3895).

Means of capture.—By line-fishing, it is taken most readily on bright and calm days. It approaches slowly and chews at the bait (erroneously believed to be sucking, Blake-Knox) and is not unfrequently captured in crab-pots, or even in the trawl.

Baits.—Crab, lug worms, sea-mud, centipedes, and shell-fish. Is a very slow taking fish, and is seldom hooked until the more ravenous kinds have ceased to bite. It nibbles but does not gorge the bait (Blake-Knox).

Breeding.—June full of ova (Dublin), April or May along the south coast of Great Britain.

As food.—Flesh bad, soft, insipid, foul smelling, of a greenish colour, and cursed by the fishermen, who in Dublin Bay say, "when you catch a poison brame, up lines and go home."

Habitat.—Shores of Norway, Sweden, and along those of the North Sea and Atlantic coasts of Europe to the Mediterranean, where it becomes rare towards its eastern extremity. One example came ashore on a winter's day in Banffshire (Edward); in the Firth of Forth they are occasionally cast ashore after easterly gales (Parnell); in February, 1836, Johnston obtained three examples, two picked up in Berwick Bay, and a third from near Bamborough, where it had been thrown on the beach after a storm: Parnell records several from Northumberland and Berwickshire; four examples were obtained from Redcar in Yorkshire (Meynell, 1844); not rare along the south coast of England, having been observed at Brighton (J. Children); Mevagissey (Dunn); not uncommon in various parts of Mount's Bay (R. Couch), while examples from Lyme Regis and Plymouth are in the national collection. It has also been recorded from North Wales (T. Eyton).

In Ireland it is found on the N. E. and W. coasts, attaining to at least 6 inches in length (Thompson). Two were observed in September, 1835, at Bangor, county Down, using a species of *nereis* as a bait; in February, 1836, one was cast ashore at Barncleugh; in June, 1838, Dr. Drummond, took one while dredging about the entrance to Belfast Bay; and Mr. McCalla obtained it at Roundstone.

I am indebted to Mr. Dunn of Mevagissey for the example figured, which was captured in September, 1881, and is shown life size.

Genus IV.—ACANTHOLABRUS, *Cuvier and Valenciennes.*

Branchiostegals five: pseudobranchiæ present. Body oblong and moderately compressed. Teeth in the jaws in a band of conical ones, those in the outer row being the strongest: no posterior canine. A single dorsal fin consisting of more than 25 *rays, of which at least* 20 *to* 21 *are spinous, none are elongated: anal with more than three spines. Scales of moderate size, those on the cheeks and opercles being imbricate. Lateral-line continuous.*

Geographical distribution.—South coast of Great Britain, to Madeira; likewise the Mediterranean.

1. **Acantholabrus Palloni,** Plate LXXV.

Lutjanus Palloni, Risso, Ich. Nice, p. 263.

Crenilabrus exoletus, Risso, Eur. Mérid. iii, p. 329.

Acantholabrus Palloni, Cuv. and Val. xiii, p. 243, pl. ccclxxv; Günther, Catal. iv, p. 91; Steind. Ich. Span. u. Port. 1869, p. 33; Giglioli, Pesc. Ital. p. 35; Moreau, Poiss. France, iii, p. 139, c. fig.

Crenilabrus luscus, Lowe, Trans. Zool. Soc. ii, p. 187 (not Linn.).

Acantholabrus imbricatus, Lowe, Proc. Zool. Soc. iii, 1839, p. 86, 1843, p. 87, and Trans. Zool. Soc. iii, p. 10.

Labrus luscus, Couch, Ann. and Mag. Nat. Hist. v, pp. 18, 742, fig. 121; Jenyns, Manual, p. 400; Yarrell, Brit. Fish. (Ed. 1) i, p. 300, c. fig.

Acantholabrus Couchii, Cuv. and Val. xiii, p. 248; Yarrell, Brit. Fish. (Ed. 2) i, p. 337, c. fig. (Ed. 3) i, p. 514; White, Catal. p. 25; Günther, Catal. iv, p. 92; Collett, Norges Fisk. p. 93.

Scale-rayed wrass, Couch, Fish. Brit. Isles, iii, p. 38, pl. cxxix.

B. v, D. $\frac{20-21}{9-10}$, P. 14-15, V. 1/5, A. $\frac{4-6}{6-8}$, C. 14-15, L. l. 40-45, L. tr. $\frac{3-4}{16}$.

Length of head $3\frac{3}{4}$ to $4\frac{1}{4}$, of caudal fin $7\frac{1}{4}$, height of body $4\frac{1}{4}$ to $4\frac{1}{2}$ in the total length. *Eye*—diameter $3\frac{1}{4}$ to 4 in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and 1 apart. Mouth rather large, the lower jaw the longer: the posterior extremity of the maxilla reaches to beneath the front edge of the eye. Posterior border and angle of the preopercle rather strongly serrated. *Teeth*—a band of conical ones in the jaws, the outer row being the larger. *Fins*—the dorsal commences above the origin of the pectoral, its spines increase in height to the last, which however is lower than the rays. Pectoral inserted below the middle of the height of the body. Anal spines increasing in length to the last. Caudal rounded posteriorly. *Scales*—five or six rows across the cheeks and seven across the opercles. A row along each dorsal spine and ray, also over the base of the caudal and anal fins. *Colours*—Deep orange, brown, violet, or blue along the back, becoming rosy on the sides and nearly white beneath. Fins orange or tinged with pink, a large oval black blotch extends along the middle of the interspinous membrane between the last three or four dorsal spines and is continued on to the first few rays: a second is likewise usually present superiorly at the base of the caudal fin. Each of the scales on the cheeks, along the shoulder and lower half of the body, may have a blue spot in its centre.

Varieties.—The number of anal spines may be reduced to four, or augmented to six, this last form having received the name of *Acantholabrus Couchii.*

Names.—*Scale-rayed wrass*, due to the existence of scales on the vertical fins. *L'Acantholabre Palloni*, French.

Habits.—Of these but little is known, but it appears to frequent deep waters.

Means of capture.—Hooks and baits.

Habitat.—An example 22 inches in length was taken in February, 1830, by a fisherman at Deadman's Point, off the south coast of Cornwall, in upwards of 50 fathoms of water: a second 10 inches long was subsequently obtained by Mr. Couch, and is now in the British Museum. It is found in the Mediterranean where it is rare, and has been obtained at Madeira.

The figure is taken from a specimen in the national collection which is 10 inches in length. This species attains to more than double that size.

Genus V.—Centrolabrus, *Günther.*

Centrolabrus, part, Cuvier and Valenciennes.

Branchiostegals five: pseudobranchiæ present. Body oblong and compressed. Teeth in the jaws in a single row of conical ones: no posterior canine. A single dorsal fin consisting of more than 20 *rays, of which at least* 16 *to* 20 *are spinous, none are elongated: anal with more than three spines. Scales of moderate size: those on the cheeks and opercles being imbricate. Lateral-line continuous.*

This genus was separated from *Ctenolabrus*, due to the teeth being in a single row instead of in a band.

Geographical distribution.—Northern Europe and Greenland, to Madeira and the Canary Isles.

1. Centrolabrus exoletus, Plate LXXVI.

Ström, Söndm. i, p. 267, No. 3.

Labrus exoletus, Linn. Syst. i, p. 479, and Faun. Suec. p. 117; Shaw, Zool. iv, p. 518; Müll. Pro. Zool. Dan. p. 46; Bonn. Atl. Ich. p. 115; Fabr. Fauna Grönl. p. 166; Retz. Fauna Suec. p. 335; Bloch Schn. p. 260; Nilss. Prod. p. 77; Fries and Ekstr. Skand. Fisk. p. 48, t. ix, f. 2.

Labrus pentacanthus, Lacép. iii, p. 503.

Crenilabrus microstoma (Couch) Thompson, P. Z. Soc. 1837, p. 55, Mag. Z. B. ii, p. 446, pl. xiv, and Nat. Hist. Ireland, iv, p. 132.

Crenilabrus exoletus, Kröyer, Dan. Fiske, i, p. 556, c. fig.

Acantholabrus exoletus, Cuv. and Val. xiii, p. 247; Yarrell, Brit. Fish. (Ed. 2) i, p. 341 (Ed. 3) i, p. 518; Nilss. Skan. Faun. Fisk. p. 277; White, Catal. p. 25; Collett, Norges Fisk. p. 94, and Christ. Vid. Selsk. Forh. 1879, p. 61.

Acantholabrus microstoma, Cuv. and Val. xiii, p. 250.

Centrolabrus exoletus, Günther, Catal. iv, p. 92.

Rock cook, Couch, Fish. Brit. Isles, iii, p. 41, pl. cxxx.

B. v, D. $\frac{18\text{-}19\,(20)}{6}$, P. 14, V. 1/5, A. $\frac{5}{7\text{-}8}$, C. 15, L. l. 32-35, L. tr. $\frac{3\text{-}4}{10\text{-}11}$.

Length of head $4\frac{1}{3}$, of caudal fin $5\frac{1}{2}$, height of body $5\frac{1}{2}$ in the total length. *Eye*—diameter 1/3 of the length of the head, nearly 1 diameter from the end of the snout, and 1 apart. Body compressed. Gape of mouth small, and cleft shallow: jaws of equal length in front, while the maxilla reaches posteriorly nearly halfway to the front edge of the orbit: lips fleshy. Both the vertical and half the horizontal limb of the preopercle strongly serrated. *Teeth*—in a single row of conical, somewhat curved and pointed ones in each jaw: no posterior canine. *Fins*—the dorsal commences over the base of the pectoral, its spines are of moderate strength and sub-equal in height, the posterior ones being nearly as long as the soft rays. Pectoral as long as the head excluding the snout. Anal commencing on a vertical line beneath the twelfth or thirteenth dorsal spine, has its last four spines somewhat exceeding the length of those in the dorsal fin, and almost equalling those of the soft rays. Caudal square, having the angles rounded. *Scales*—three rows across the cheeks: some on the subopercle. *Lateral-line*—descends forming a curve beneath the soft portion of the dorsal fin. *Colours*—of a rich brown along the back, becoming shaded with yellow on the sides, and sometimes silvery on the chest; while some narrow yellow lines run along the rows of scales. A dark spot on the upper portion of the eye. Two blue bands pass from the eye to the angle of the mouth, and two more along the preopercle. A dull bluish mark upon the opercle. Fins silvery stained with yellow, the dorsal and anal lightest externally: a single line of dark marks along the spinous dorsal, becoming two posteriorly, and on the soft portion: anal similarly coloured. Caudal with a white outer margin, having a black base which is extended over the middle portion of the fin being darkest posteriorly.

Varieties.—Couch's figure gives seventeen spines to the dorsal fin, and a broad dark band or blotch over the anterior half of the free portion of the tail.

Names.—*Rock cook, small-mouthed wrass.*

Habits.—Frequents rough stony gound and deep waters, feeding on minute crustacea and dead animal substances, consequently mostly seen while crab-pots are in use, or during the summer months, when the young likewise frequent rock pools.

Means of capture.—Mostly in crab-pots, going in after the baits, which it tears little bits off and sucks them in; while, owing to its small mouth, it is rarely captured by line fishermen.

Habitat.—Coasts of Greenland, Norway and Sweden, to those of the British Isles. Two small examples were caught in Kirkwall Bay in December, 1850 (W. Baikie, Zool. 1853, xi, p. 4019); it has been observed at Banff (Edward); and along the south coast of our western counties. Lieutenant Spence sent a specimen from Cawsand to the British Museum. I have taken several at Dawlish. Couch did not consider it rare in Cornwall.

In Ireland—it has been taken on the N. E. and W. coasts (Thompson); at Carnlough in Antrim in June, 1836, by Dr. Drummond, and a second by the Ordnance Survey, which latter party likewise obtained it at Lough Foyle, county Londonderry; and Mr. M'Calla recognized it at Roundstone.

The example figured was captured by myself in a rock pool near Dawlish in August, 1881.

It is said not to exceed four or five inches in length.

Genus VI.—Coris, *Lacépède.*

Hologymnosus, sp. Lacép; *Halichœres*, sp. Rüpp.; *Pseudocoris*, *Hemicoris*, and *Ophthalmolepis*, Bleeker.

Branchiostegals six: pseudobranchiæ present. Body oblong and compressed. Teeth in the jaws, the anterior ones being conical and free, while laterally the outer row is composed of larger teeth than the inner: a posterior canine pointing forwards, often exists at the angle of the mouth. A single dorsal fin with eight or nine spines: anal with three. Scales small, 50 or more rows: none on the head (except in C. lineolata). Lateral-line continuous.

Geographical distribution.—From the south coast of Great Britain extending to the Atlantic and the tropical portion of both hemispheres, as well as the adjacent regions.

1. Coris julis, Plate LXXVII, fig. 1 *male*, fig. 2 *female.*

Synonymy of males.

Julis, Rondel. vi, cap. 7, p. 180; Salviani, p. 219; Gesner, Aquat. iv, p. 464; Aldrov. i, c. 7, p. 39; Jonston, i, tit. 2, c. 1, art. 5, t. xiv, f. 3; Willugh. p. 324, pl. x, f. 1; Ray, Syn. p. 138. *Labrus*, no. 7, Artedi, Gen. p. 34, no. 1, Synon. p. 53. *Mœnas*, Klein, Miss. Pisc. v, p. 45, no. 4, t. viii, f. 8. *Labrus*, sp. Gronov. Mus. Ich. ii, sp. 184 and Zooph. no. 241. *Sparus niloticus*, Hasselq. Iter Palæs. p. 387. *Rainbow wrasse*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 343.

Labrus julis, Linn. Syst. i, p. 476; Shaw, Zool. iv, p. 525; Bloch, t. cclxxxvii, f. 1; Bonn. Atl. Ich. p. 108, pl. iii, f. 199; Lacép. iii, p. 493; Bl. Schn. p. 247; Donovan, Brit. Fish. iv, pl. xcvi; Turton, Brit. Fauna, p. 99; Risso, Ich. Nice, p. 227; Jenyns, Manual, p. 397; Gronov. ed. Gray, p. 79.

Julis Mediterranea, Risso, Eur. Mérid. iii, p. 309; Yarrell, Brit. Fishes (Ed. 1) i, p. 291, c. fig. (Ed. 2) i, p. 344 (Ed. 3) i, p. 521.

Julis speciosa, Risso, l. c. iii, p. 311; Cuv. and Val. xiii, p. 375.

Julis vulgaris, Fleming, Brit. Anim. p. 210; Cuv. and Val. xiii, p. 361, pl. ccclxxxiv; Bonap. Faun. Ital. Pesc. c. fig.; Kröyer, Dan. Fiske, i, p. 561, c. fig.; Moreau, Poiss. France, iii, p. 141.

Julis festiva, Cuv. and Val. xiii, p. 374.

Julis melanura, Lowe, Trans. Zool. Soc. iii, p. 12.

Julis julis, White, Catal. p. 26.

Coris julis, Günther, Catal. iv, p. 195; Steind. Ich. Span. u. Port. 1868, p. 35; Winther, Ich. Dan. Mar. p. 27; Giglioli, Pesc. Ital. p. 35.

Rainbow wrasse, Couch, Fish. Brit. Isles, iii, p. 49, pl. cxxxiv.

Synonymy of females and young.

Labrus Giofredi, Risso, Ich. Nice, p. 228, pl. ix, f. 23.

Julis Giofredi, Risso, Eur. Mérid. iii, p. 310; Cuv. and Val. xiii, p. 371, pl. ccclxxxv; Bonap. Faun. Ital. Pesc. pl. fig. 2; Moreau, Poiss France, iii, p. 145, c. fig.

Coris giofredi, Günther, Catal. iv, p. 197; Giglioli, Pesc. Ital. p. 35.

B. vi, D. $\frac{9}{12-13}$, P. 12-13, V. 1/5, A. $\frac{3}{11-12}$, C. 13-14, L. l. 75-78 (80), L. tr. 3/24, Vert. 9-10/15-16.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin 7 to $7\frac{1}{2}$, height of body $4\frac{1}{2}$ to 5 in the total length. *Eye*—diameter 5 to 6 in the length of the head, $1\frac{1}{2}$ to 2 diameters from the end of the snout, and 1 to $1\frac{1}{2}$ apart. Jaws of the same length anteriorly, the snout more elongated in adult males than in females and young, partly due to the comparatively smaller eye: the maxilla extends posteriorly to below the

hind nostril. Opercular bones entire. *Teeth*—the four anterior ones in either jaw elongated: there are about nine in the outer row along either ramus of the upper jaw, and ten in the lower: a posterior canine at the angle of the mouth. *Fins*—the dorsal commences above the hind edge of the bony opercle, the three first spines in the male being as a rule somewhat elevated and nearly equalling half the height of the body below; the soft rays are simply divided at their outer end and somewhat longer than the spines of the fin. Pectoral as long as the head excluding the snout. Ventral a little shorter than the pectoral. Third anal spine the longest: soft portion similar to rayed part of the dorsal: caudal rounded. *Scales*—M. Moreau thought the number of scales were more numerous in the female than in the male, but I do not find this to be the case in a large series of specimens. *Lateral-line*—curves downwards opposite the ninth or tenth dorsal ray. *Colours*—these are very various: those of the *male* being purplish or bluish-brown along the upper half of the body, and silvery-white below; along this upper half runs a broad yellowish-white, and generally indented line which commences behind the eye and is continued to the base of the caudal fin. A small round black spot on the end of the opercle. Dorsal fin yellowish with a purple or orange outer edge, while a purplish or greenish-yellow spot with a curved upper edge is present between each ray. A black spot in the axil of the pectoral fin. A large oval black or bluish spot exists on the anterior portion of the dorsal fin, between the first and fourth spines: the anal is similar to the soft dorsal but lighter. *Female*—upper third of the body purplish, with a light yellow band passing from the eye to the base of the caudal fin: lower two-thirds of the body silvery with one or more yellow longitudinal bands. A dark spot in the axil of the pectoral fin, and another behind the opercle as in the male. Fins reddish.

Varieties.—Those of colour are exceedingly numerous: in some the indented light lateral band is wanting, being broken up by numerous vertical blotches; while the dorsal fin is of a light colour, *Coris speciosa:* or the dorsal fin may be nearly black *C. melanura.* Pennant most correctly observed that this fish is remarkable for the elegant distribution of its colours, green, yellow, and purple, which are changeable in various directions of light.

Names, origin of.—*Rainbow wrasse*, due to its various tints, and *indented striped wrasse* (*male*), owing to the character of the light lateral band. *Le girelle*, French.

Habits.—Of these but little appears to have been recorded. Its food appears to be small crustacea, molluscs, and similar articles which it searches for among coral rocks.

In an aquarium "their usual habit is to hide in a bed of shingle—preferring such to sand—from which they can only be dislodged by violence. When one of them is disturbed, it darts out of its stony bed, and vanishes like a flash of lightning" (H. Birchell, Zool. 1876, p. 5159). It "is greedy for small crustacea. I have seen it chase a Cook's wrasse, *Labrus mixtus*, ten times its own size, which was swimming about with a crab in its mouth, round and round a long tank, tearing off the legs of the unfortunate crab as it dangled from the mouth of its captor" (l. c.). Its bite in olden times was considered poisonous by the fishermen in the Mediterranean, but Rondelet tells us how several attacked him while bathing near Antipolis, biting his legs and his heels, but which was not followed by any poisonous results.

As food.—It does not appear to be held in any estimation, but Galen and Bloch stated it to be wholesome, while Ælian says its flesh is poisonous.

Habitat.—From the south coast of England to the Azores and Canary Islands: likewise extending through the Mediterranean, where it is very common.

A male, a little over 7 inches in length, was taken in Mount's Bay in 1802, and came into the possession of Donovan: Leach obtained examples of the young and half-grown from Plymouth Sound and South Devonshire, which are still in the British Museum.

The largest recorded British specimen was 7 inches in length.

Order II—ANACANTHINI.

All the fin rays articulated, the ventral fins, when present, being jugular or thoracic. Air-bladder, if existing, not having a pervious pneumatic duct.

The order of spineless fishes, or *Anacanthini*, has been divided into two groups, in one both sides of the head are symmetrical, in the other not.

First Group—Anacanthini gadoidei.

Both sides of the head symmetrical.

Family I—GADIDÆ, *Cuvier.*

Pseudobranchiæ, when present, glandular and rudimentary. Body more or less elongated. Gill-openings wide: gill-membranes, as a rule, not being attached to the isthmus. From one to three dorsal fins, occupying nearly the entire length of the back, the rays of the last fin being well developed: one or two anal fins: caudal usually free, but sometimes united to the dorsal and anal. Ventrals jugular, consisting of several rays, or should they be reduced to a filament the dorsal fin is divided into two. Scales cycloid, and of moderate or small size. Air-bladder and pyloric appendages usually present.

Some of the genera, of which representatives have been recognized in this country, have three dorsal and two anal fins, as *Gadus:* or two dorsals and a single anal, as *Merluccius*, *Phycis*, *Molva*, *Lota*, and *Motella:* while in *Brosmius* there is only one dorsal and one anal fin.

Geographical distribution.—The cod family is composed of surface and littoral forms, those living off our coasts having been found at a depth rarely exceeding a hundred and twenty or hundred and fifty fathoms. These fishes are extended through the Arctic and temperate regions of the northern hemisphere, becoming almost unknown in the tropics, and very rare to the south of the line. Although as a rule it is composed of marine genera, still fresh-water representatives are not unknown, as the burbot, *Lota vulgaris*, which would seem to be descended from a marine ancestry, for like its ocean relatives its air-bladder is destitute of ossicles connecting it with the internal ear (see Introduction).* Reliable evidence confirmatory or the reverse of this view, or whether marine residents among the Gadidæ may be detected living in fresh waters, thus becomes desirable. For should a migration from the sea to fresh waters be undertaken without occasioning deleterious results, it would tend towards confirming the possibility of the correctness of the foregoing deduction. I will now quote (with permission) from a communication which I received from Lord Ducie in September, 1881, directly bearing on this question:—

"I have just returned after having spent two months in the Norwegian Fjords, in my steam yacht. In Midgulen Lake, 61° 43′ N. Lat. and 5°. 53′ E. Long. from Greenwich, I found pollack living in the fresh water. This lake is about five hundred yards from the sea, with which it is connected by a river averaging about

* Burbot and Air-bladders of Fishes, F. Day, Proceedings Cotteswold Naturalists' Field Club, 1879-80, vii, pp. 221-242.

twenty yards in width by three feet in depth. There are no falls, but three or four rapids, which at high water are (as regards those nearest the sea) submerged, the upper ones being but slightly affected. A small boat could perhaps row from the sea into the lake under favourable circumstances: while the strength of the current could not prevent a fish of the weakest sort from entering the lake: at the same time no sea-water can get in—the more so that the head of the Fjord itself is fresh on the surface. This lake is about one and a-half miles in length, its depth unknown, it is fed by the snow melting on the hills far and near, while its water is perfectly and entirely fresh. Trolling with a phantom minnow resulted in the capture of fourteen sea-trout, but the sport was frequently interrupted by attacks from pollack. We were compelled to catch twelve or fourteen (all about 2 lb. weight) as they would not leave us alone. A flock of sea-gulls on the lake behaved as they did on the Fjord outside, looking as if they were trying to strike herring on the surface. On returning to the yacht we were informed by a native that many species of sea-fish entered the lake, and among them herring. On the south side of the Sogne Fjord, about thirty or forty miles from the sea, is a Fjord called Fuglescœt, a small branch of which is the Sörejde Fjord. The chart showed a lake close to the sea and therefore easily accessible in a boat. Here we found a small river, about one hundred yards long, flowed from the lake to the sea, which, though rapid at low water, was nearly checked at high water. Still the fresh water always pushed out. This lake was two miles long and fed by two snow streams. Using the artificial minnow, for the first half-hour there was no 'run,' then a cod of 1 lb. was taken, next a coal-fish of 2 lb., then a pollack of 3 lb., and all these at the inland extremity of the lake, the pollack being actually in the snow-water stream. There was no sign whatever of a fresh-water fish. Not a trout rose along the woody banks where trout would be sure to be were they there. In short, the sea-fish had complete possession of this lake, which, as in the other instance, was entirely fresh. These were not lagoons but rocky mountain (glacier) basins, with rapid streams entering and issuing."

I have already alluded (p. 54) to marine fishes in the Baltic having become acclimatized to a residence, where the character of the water has gradually changed from saline to fresh, so that the herring and some other sea forms unable to obtain access to the Arctic Ocean deposit their eggs in potable water, and the *Cottus quadricornis* even migrates to the rivers.* But the foregoing instances show how marine Gadidæ may voluntarily enter and reside in fresh waters, while we have no reason to suppose that were their return to the sea cut off they could not live and continue their species in this new locality.

These fish, especially the cod, occasionally shift their ground, some cause, probably absence or presence of some peculiar food, inducing them to leave localities they had previously frequented: thus the London market used to be supplied from the Orkneys and the Dogger Bank, but during the present century these fish have extended their range to off Lincolnshire and Norfolk in sufficient numbers to render their capture remunerative.

Fisheries for cod have existed in the north many centuries, as we know that one in the German Ocean was recognized before A.D. 1368, because in that year the city of Amsterdam obtained permission from the King of Sweden to form an establishment in the Island of Schonen for the purpose of carrying it on. But prior to John Cabot's re-discovery of Newfoundland in A.D. 1496 the fisheries of the greatest importance in Europe were off our western isles and the coast of Iceland. English fishermen must have resorted to these latter localities prior to A.D. 1415, because we read that Henry V was disposed at this period to accord satisfaction to the King of Denmark for certain irregularities committed in those seas by his subjects. But since the commencement of the sixteenth century the Newfoundland fisheries have become the most important

* For other instances of fishes of marine genera living in fresh waters as gobies, blennies, herrings, &c., see *Introduction*.

in the northern hemisphere. Cod fisheries, frequented by British fishermen, exist to a greater or less extent from Iceland to the south coast of England, and as far west as Newfoundland. They are largely carried on in these islands, especially to the north and west of Scotland, and likewise off the maritime counties of Ireland. But a detailed account of these fisheries, their rise and their present condition, would require more space than the limits of the present work would permit.

Means of capture.—The cod, or white fishery, in which is here included the common cod, haddock, whiting, bib, pollack, coal-fish, ling, hake, torsk, and their family allies, is one of great national importance in several ways, more especially as the means of obtaining a large amount of good and wholesome food, as well as giving employment to fishermen and many traders. The members of the cod family are generally gregarious, and collect in large shoals at particular spots, and although in the following observations the common cod will be more especially mentioned, their fisheries are representative ones of what is likewise being carried on to secure other members of the family. The three forms which are perhaps the most valuable in an economic point of view are the common cod, *Gadus morhua*, haddock, *G. æglefinus*, and whiting, *G. merlangus*. The common cod as a rule is in the best condition from the end of October to the beginning of February, the cold season being that in which members of this family attain the greatest perfection for the table, although some are employed for this purpose throughout the year. Living as the cod does, in water of from 25 to 150 fathoms, it is found feeding mostly near the ground on submerged banks, where it can obtain appropriate food. Being a voracious feeder the experienced fisherman takes advantage of its appetite, and with long- or hand-lines, as well as nets, seeks his game in suitable localities. *Long-lines* or *bulters* (see Introduction) are employed up to at least seven miles in length, while the Norwegians also use *trawl-lines* and even nets. The baits used for the lines are various. Small fish, as lamperns, *Petromyzon fluviatilis*, sand launce, *Ammodytes*, herrings, *Clupea harengus*, pilchards, *C. pilchardus*, sprats, *C. sprattus*, whelks or buckies as they are termed in Scotland where they are much approved of, due both to their toughness and attractiveness to the cod and ling: limpets, mussels, various crustacea, and testacea, as well as lug-worms, and even the roe of the cod itself. These lines if slightly raised off the ground by floats, or buoyed at both ends, so that merely the middle portion rests on the ground, cause the bait to be less hidden by weeds, are better seen by the fish, and less consumed by crabs and star-fishes. The long-lines off our coasts are shot about slack water and heaved up in about six hours, when the tide has nearly finished. Sharks, dog-fishes, and porpoises are great enemies to this occupation, carrying away the hooked fish. *Hand-lining* (see Introduction) is used very similarly to long-lining, only employed by men fishing from boats, while it is most efficacious when cod are not at the bottom but rising more towards the surface, as when in pursuit of the herring, or other fishes. *Whiffing*, or surface line-fishing, and *beam-trawling*, are likewise employed for taking some members of the cod family.

The fish having been captured, the question for the fishermen is, if they shall be killed at once and prepared in a suitable manner by means of ice or salt for a near or distant market; or whether they shall be retained alive by being kept in appropriate places. Smacks with wells in them were first used in England at Hawick, about A.D. 1712, said to have been copied from some Dutch fishing boats. This well, as now made, is not simply a tank fitted into the smack, but a constituent portion of the vessel itself. Two strong and water-tight bulkheads are constructed across the width of the smack, enclosing a large portion of the centre of the vessel, while they reach in height from the deck to the keelson. Large holes are bored through the sides of the smack below the water-line, permitting a constant stream being kept up. Here cod captured at a moderate depth will live for a considerable time, but should they or ling have been hooked at a great depth they will not usually thrive. Rough weather is very detrimental to fishes in welled smacks, occasioning many deaths. A plan is likewise adopted

for keeping cod alive after arriving in port, by transferring them to cod-chests,* which are kept floating in docks, or other suitable places. Those at Grimsby and Harwich are about seven feet long and two deep, the bottom and sides being made of stout battens placed a short distance asunder in order to admit a constant penetration of water from outside. The top is planked, but possesses an oblong opening and movable cover for introducing or removing the fish. To the ends of each cod-chest ropes or chains are attached in order to easily move it about. About forty good sized cod will live about a fortnight in one of these chests, and about four hundred are constantly in use at Grimsby. For sending to market the cod are removed, killed by blows on the head with a mallet or short club, and then sent to London, where they are known as "live cod," and attain the highest price. Owing to the method employed in killing them they can be crimped some hours subsequently.

Diseases.—The members of the cod family appear to be very susceptible to disease, especially of the vertebral column, which may become shortened, and has been compared by Dr. Dyce to a form of rickets, occasioning angular or lateral curvature. This may cause a diminution in the extent of surface covered by the dorsal or anal fins, which from this, or other causes, vary greatly in the number of their rays. Sometimes it gives the fish a hunch-backed appearance, or the proportionate length of the head to that of the body becomes far greater than is normally the case. Blindness is not rare among these fishes, especially when in confinement. In the thirteenth volume of the New Sporting Review may be found a most interesting account of a visit to Colonel McDowell's vivarium for codfish in the Mull of Galloway. An excavation was formed in the rock about fifty feet in diameter, and at low tide about eight feet of water remained in this basin, and six feet more at high tide. It was observed as a curious fact that fish when they have remained long in this pond always became blind; this was supposed to be due to there not being sufficient shelter for them from the heat and glare of the sun owing to the shallowness of the water as compared with the depths of their usual haunts. During the past year when visiting an aquarium in the north, supplied with pure sea-water, I observed several of these fishes blind with one or both eyes: the eyeball in those which were not totally deprived of vision moved on the blind, similarly to that on the sound side. In some examples of the common cod the pupil instead of being circular was transversely oval, or even pear-shaped, probably due to an adhesion of the posterior surface of the iris to the lens or its covering. The pupil was either dull or greenish, while in some a film appeared to cover the eye externally. Without the opportunity of examining these eyes it would be difficult to determine the exact lesion, but I am disposed to think that the theory advanced at Colonel McDowell's was the correct one.† I was lately observing a fine school of bibs which had been upwards of eighteen months in the Westminster Aquarium, where the water had not invariably been particularly clear, nor had all of it come direct from the sea. Among these numerous cases of blindness were not apparent. Before, however, attributing this immunity entirely to the character of the light we have to consider the relative susceptibility of such in the common cod to what obtains in the bib. The cod, although hardly a deep-sea fish, resides in localities at 25 to 100 or more fathoms, while the bib, although it lives in deep waters during the winter, approaches the shore in spring and summer, and consequently does not so invariably remain in dark or semi-dark places as does the cod. The presence of parasites may not only alter the colours of the fish as shown by its being of an unnaturally light tint, but also by the infected spots turning black as seen in the speckled cod (p. 225).

Genus, I—Gadus, *Cuvier.*

Merlangus, Cuvier: *Morhua*, Risso: *Pollachius*, Nilsson: *Melanogrammus* and *Brachygradus*, Gill: *Boreogadus*, Günther: *Æglefinus* and *Gadulus*, Malm.

* These have been described by many recent authors, as Buckland, Holdsworth, &c.

† Mr. Dunn observes that injuries caused by hooks or blows on the snout may occasion blindness in these fishes.

Branchiostegals seven: pseudobranchiæ, if present, rudimentary. Teeth in a band in the jaws, present on vomer, none on the palatines or tongue. A barbel present or absent below the chin. Three dorsal and two anal fins: ventral with six or more rays: caudal distinct. Air-bladder present. Cœcal appendages numerous.

The reason why these fishes were termed *Asinus* by the ancients has by some been considered to have reference to their colour: while others believe it to be due to their having been carried to market on the backs of asses. Yarrell, however, advanced another suggestion that the term was originally intended for the *haddock*, in which (he says) the shoulder blotch frequently extends over the back uniting with that on the opposite side, and thus reminding the observer of the dark stripe over the withers of an ass. A slight objection might be raised as to how the Greeks and Latins conferred this term on a species which does not exist in their seas. The name has also been supposed to refer to the hake.

This genus was subdivided by Cuvier into (1) those in which three dorsal fins and a submandibular barbel were present, *Gadus:* and (2) those in which the barbel was absent, *Merlangus.*

A. *Upper jaw the longer, its outer row of teeth enlarged* (*Gadus*).

a. Barbel present.

1. *Gadus morhua*, D. 13-15/16-19/17-21, A. 17-19/16-18. Greenish or olive: lateral-line white.
2. *Gadus æglefinus*, D. 14-16/20-24/19-21, A. 24-25/20-22. A black shoulder blotch and black lateral-line.
3. *Gadus luscus*, D. 12/20-23/19-20, A. 27-32/17-20. Copper-coloured, with broad vertical bands.
4. *Gadus minutus*, D. 12-15/19-25/17-22, A. 25-29/17-22. Silvery.

b. No barbel below chin.

5. *Gadus merlangus*, D. 13-16/18-23/19-21, A. 30-35/20-24. Silvery, with a dark axillary spot.

B. *Lower jaw the longer: its outer row of teeth enlarged* (*Boreogadus*).

6. *Gadus poutassou*, D. 12-13/12-14/22-24, A. 34-38/20-25. Silvery.

C. *Lower jaw the longer: teeth in upper jaw of equal size* (*Pollachius*).

a. Barbel present.

7. *Gadus virens*, D. 12-14/20-22/20-22, A. 24-27/20-23. Gray along the back, silvery sides.

b. No barbel below chin.

8. *Gadus pollachius*, D. 11-13/16-20/15-19, A. 24-31/16-21. Dull greenish along the back.

A. *Upper jaw the longer: its outer row of teeth enlarged* (*Gadus*).

a. Barbel present.

1. Gadus morhua, Plate LXXVIII.

Morhua vulgaris, Bellon. de Aquat. p. 128. *Molva*, Rondel. ix, c. 14, p. 280; Gesner, pp. 88, 102. *Morhua s. molva*, Aldrov. iii, c. 6, p. 289; Jonston, i, tit. 1, c. 1, Art. 2, t. ii, f. 1. *Asellus major*, Schonev. p. 18; Willugh. p. 165, t. L. M. i, f. 4; Ray, Syn. p. 53; Rutty, i, p. 353. *Gadus*, sp. Artedi, Syn. p. 35, no. 6. *Callarias*, Klein, Pisc. Miss. v, p. 6, no. 4, t. i, f. 1; Ascan. Icon. t. iv and xxvii.

Common cod-fish, Pennant, Brit. Zool. (Ed. 1776) iii, p. 172 (Ed. 1812) iii, p. 231; Low, Faun. Orcad. p. 190. *Morue*, Duhamel, Pêches, ii, Sec. i. p. 37, pl. xii, f. 1.

Gadus morhua, Linn. Syst. i, p. 436; Bl. Fische Deuts. ii, p. 145, t. lxiv; Gmel. Linn. p. 1162; Bonnat. Atl. Ich. p. 47, pl. xxviii, f. 101; Shaw, Zool. iv, p. 131, pl. xxii; Lacép. ii, p. 369; Bl. Schn. p. 7; Donovan, Brit. Fish. v, pl. cvi; Turton, p. 89; Mitchell, Lit. and Phil. Trans. New York, i, p. 367; Faber, Fische Isl. p. 104; Richards. Faun. Bor.-Amer. Fish. p. 242; Jenyns, p. 440; Nilss. Skand. Faun. iv, p. 537; Brandt and Ratzeb. i, p. 46, t. ix, f. 3; Kröyer, Dan. Fiske, ii, p. 1, c. fig.; Cuv. Règ. Anim. Ill. Poiss. pl. cvi, f. 1; Malmgren, Spets. Fiskfauna, p. 528 and Wiegm. Arch. 1864, p. 297; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Johnston, Berwick. Nat. Field Club, 1838, p. 173; Swainson, Fishes, ii, p. 299; McIntosh, Fish. N. Uist. Proc. Roy. Soc. Edin. v, 1862-66, p. 614 and Fish. St. Andrew's, p. 177; Thompson, Nat. Hist. Ireland, iv, p. 178; Günther, Catal. iv, p. 328; Gill, Proc. Ac. Nat. Sc. Phil. 1863, p. 234; Schlegel, Dieren Neder. p. 77, pl. vii, f. 1; Malm, p. 480; Gilpin, Proc. and Trans. Nov. Scot. Inst. Nat. Sc. ii, pt. 1, p. 101; Winther, Ich. Dan. Mar. p. 27; Collett, Norges Fiske, p. 103; Moreau, Poiss. France, iii, p. 235.

Gadus callarias, Fries and Ekstr. Skand. Fish. p. 101, t. xlvii; Ekstrom, Mörkö, p. 230; Gronov. ed. Gray, p. 131.

Morhua vulgaris, Fleming, p. 191; Yarrell, Brit. Fish (Ed. 1) ii, p. 143, c. fig. (Ed. 2) ii, p. 221 (Ed. 3) i, p. 524; Parn. Wern. Mem. vii, p. 333 and Fish. Firth of Forth, p. 173.

Morhua callarias, Cuv. Règne Anim.; White, Catal. Brit. Fish. p. 87.

Cod, Couch, Fish. Brit. Isles, iii, p. 53, pl. cxxxv.

Synonymy of immature.

Asellus varius vel striatus, Schonev. p. 19; Jonston, t. xlvi, f. 4; Willughby, p. 172, t. L. M. i, f. 1; Ray, Syn. p. 54. *Gadus*, sp. Artedi, Syn. p. 35, no. 4, Spec. p. 63, no. 4, Genera, p. 24, no. 4; Gronov. Zooph. no. 319; *Gadus callarias var. a.* Fabr. Fauna Grœnl. p. 144. *Variable cod-fish*, Pennant, Brit. Zool. (Ed. 1812) iii, p. 239. *Callarias*, sp. Klein, Pisc. Miss. v, p. 5, no. 1, 5, t. i, f. 2, no. 6, 7, t. ii, f. 1, 2.

Gadus callarias, Linn. Syst. i, p. 436; Bl. Fische Deuts. ii, p. 109, t. lxiii; Gmel. Linn. p. 1166; Bonn. Atl. Ich. p. 46, pl. xxviii, f. 100; Shaw, Zool. iv, p. 138; Lacép. ii, p. 409; Bl. Schn. p. 6; Pall. Zoogr. iii, p. 182; Turton, p. 89; Jenyns, p. 441; Faber, Fische Isl. p. 109; Ekstr. Fische Mörkö, p. 230 and Vet. Akad. Handl. 1834, p. 38; Gronov. ed. Gray, p. 131; Brandt and Ratzeb. i, p. 49, t. ix, f. 2; Thompson, P. Z. S. 1837, p. 57.

Gadus barbatus, pt. Linn. Syst. i, p. 437.

Morhua callarias, Cuv. Règne Anim.; Yarrell, Brit. Fishes (Ed. 1) ii, p. 151, c. fig. (Ed. 2) ii, p. 231.

Dorse, Couch, Fish. Brit. Isles, iii, p. 66, pl. cxxxvii.

Synonymy of Greenland variety.

Gadus barbatus, Fabr. Faun. Grœnl. p. 146; Mohr, Isl. Nat. p. 68; Ascan. Icon. t. v.

Gadus ruber, Lacép. v, p. 673; Holböll, Goth. Nya Handl. iv, p. 31, c. fig.

Gadus ogak, Richards. Faun. Bor.-Amer. Fish. p. 246; Gaim. Voy. Scand. Atl. Poiss. pl. xix.

Synonymy of diseased forms.

Gadus macrocephalus, Tiles, Mém. Acad. Sc. St. Petersb. 1810, ii, p. 350, t. xvi; Günther, Catal. iv, p. 330; Kner and Steind. S. B. Ak. Wien, 1870, lxi, p. 440.

Cephus macrocephalus, Swainson, Fishes, ii, p. 300.

Gadus punctatus, Turton, p. 90; A. Smith, Proc. Roy. Phy. Soc. Edin. 1864-65, iii, p. 302; Dyce, Ann. and Mag. Nat. Hist. 1860, v, p. 366.

Morhua punctata, Flem. p. 192; Jenyns, p. 442.

Lord-fish, Yarrell, Brit. Fish (Ed. 1) i, p. 164, c. figure; Cobbold, Proc. Roy. Phy. Soc. Edin. 1854-1858, i, p. 51.

Morrhua macrocephala, Day, Journ. Linn. Soc. Zool. xiv, p. 689, pl. xiv.

B. vii, D. 13-15/16-19/17-19(21), P. 16-19, V. 6, A. 17-19/16-18, C. 28, Vert. 19/32.

Length of head $3\frac{2}{3}$ to $4\frac{1}{2}$, of caudal fin $6\frac{1}{2}$, height of body 4 to 5, or even more in the young, in the total length. *Eye*—diameter $4\frac{1}{4}$ in the young to 7 in the adult in the length of the head: $1\frac{1}{2}$ diameters in the young to 2 in the adult from the end of the snout, and $1\frac{1}{4}$ in the young to 2 in the adult apart. Body much thickest anteriorly. Nostrils nearer the eye than to the end of the snout. Snout conical. Mouth wide, with a deep cleft. Upper jaw the longer: the posterior extremity of the maxilla reaches to beneath the first third or middle of the eye. A barbel generally as long as the eye, but sometimes shorter, is situated below the chin. *Teeth*—cardiform with an outer and much enlarged row in the upper jaw, in a V-shaped patch on the vomer, absent from the palatines and tongue. *Fins*—the first dorsal somewhat triangular, it commences over or slightly posterior to the base of the pectoral, its fourth ray being the longest and about equal to the extent of the base of the fin, from it they diminish in height to the last, which is very short. There exists a very short interspace between the bases of the two first dorsal fins, the fourth ray being somewhat the longest but not quite equal to half the length of the base of the fin. They decrease in height to the three last which are short. A very short interspace exists between the second and third dorsal fins, and a longer or shorter interspace occurs between its termination and the base of the outermost caudal rays. The anterior anal fin commences on a vertical line below the fourth or fifth ray of the second dorsal, and a short interspace exists between it and the origin of the second anal, which is similar to the third dorsal. Caudal slightly emarginate or square at its extremity. Ventrals small, inserted rather before the base of the pectorals, which are as long as the postorbital portion of the head. Vent situated on a vertical line beneath the first rays of the second dorsal fin. *Scales*—small and cycloid. *Lateral-line*—passes backwards from opposite the upper edge of the orbit, attaining below the centre of the second dorsal fin nearly the middle of the depth of the body, from whence it is continued straight to the centre of the base of the caudal. *Cœcal appendages*—numerous and short. *Colours*—greenish or grayish, or olive, and occasionally covered with yellow or brown spots along the back and upper two-thirds of the body, its lower portion pure white. Lateral-line white, especially in its lower half. Fins gray, becoming darkest towards their outer edges.

Considerable discussions have arisen respecting what is *Gadus callarias*, Linn., or the *dorse*. The Linnean Society of London possess among Linnæus's collection of fish an example of *Gadus morhua*, labelled *G. callarias*, and also *Sma Torsk*. It has D. 14/18/20, A. 19/19, while the length of the head is $3\frac{1}{2}$ in that of the body. Nilsson observes that in *G. morhua*, the length of the lower jaw is half that of the head, or the distance from the snout to the posterior edge of the eye: whereas, in *G. callarias* it is less than half the length of the head, and equals the distance from the snout to the middle of the eye. Thompson considered that he obtained two examples of this fish at Youghal in the autumn of 1834, and that Mr. Marshall took another, 8 inches long, in the county of Antrim. Mr. Cornish considers the *dorse* by no means uncommon in Cornwall, its back being of a rich brown colour (Zool. 1874, p. 4080). All the eatable cod fish I saw along the south coast were *G. morhua*, the fishermen in some localities insisting that this local form differed from the common cod, whereas others believed it to be the same. Respecting *Gadus punctatus*, Turton, that author evidently gave a wrong description of his fish, for he defines it as having "upper-jaw longer" and says it differs from *G. morhua* "in the lower jaw being considerably longer."

Varieties of form.—Fishermen distinguish two races—(1) the Southern or Dogger-bank-cod, having a pointed and somewhat elongated snout, the body being of a dark colour; and (2) the North or Scotch-cod, having a blunter snout, and being of a light ash-gray. The two forms are said to mix off Northumberland.

Yarrell having observed a "Lord-fish," *G. macrocephalus*, Tiles, at the mouth of the Thames considered the appearance due to disease. Gurney (Zool. May 16th, 1851) remarks upon having seen one of these fish caught at Lowestoft, and called by the local fishermen "a lord,"* resembling Yarrell's figure. Thompson also obtained two at Belfast and considered them deformities. Cobbold found this shortening of the body, which occasions the comparatively large head, to be due to the coalescence of a great number of the vertebræ immediately succeeding the bones of the head. My example I find, on dissection, likewise suffered from coalescence of several vertebræ, but all in the caudal region. Gill alludes to a Labrador specimen which possessed two barbels below the chin placed one behind the other. *Of colour*—Turton's "speckled cod" may have been so coloured due to disease—as the presence of parasites. Mr. Sim in November, 1881, obtained two examples at Aberdeen which he kindly forwarded to me. They were of a light colour, but speckled, especially over the upper half of the body and fins with small black dots, which under a magnifying glass were seen to be round elevations, some of which had small orifices in their centres. The fins were edged with black. Thompson likewise obtained speckled examples in Ireland, agreeing with Turton's fish, but which he considered as varieties of the common cod. *Codlings* are frequently yellow* or even of a red colour, while living among rocks they do not assume their adult livery until they change their residence. Edward at Banff alludes to occasionally meeting with red codlings, which most frequently had yellow fins, none exceeded the size of the common haddock. Thompson saw one in Ireland of a pale lilac-gray colour, closely studded over with large reddish-gray spots, which were as close together as in any species of trout. Parnell found the red cod the firmest for eating, and remarked that they resided in very deep water feeding almost entirely on young lobsters and starfish.

Names.—*Poullach*, Moray Firth, or if half grown, *duncan* (Gordon); *kleg* and *keeling*, a large kind of cod; also *chelynge* (Halliwell). *Dole-fish* is that form in which the fishermen of the North Sea had their pay or "dole." *Blens*, while the young are generally known as *codlings*. In the Channel those the size of a whiting are termed *codlings* and *skinners*: when larger, *tumbling* or *tamlin-cod* (Yarrell). *Haberdine* or *salted cod*, in Westmorland. *Le gade morue*, French. *De Kabeljaauw*, Dutch.

Habits.—A voracious fish which as a rule feeds near the ground. It is indiscriminate in its choice, consuming whatever inhabitants of the deep it is able to master. The most elaborate investigations into the life history of this fish have been made by Sars off the coast of Norway, and from whose reports in the fishery department much of the following is derived, for its habits in any part of Europe are nearly identical with those in our seas. Large cod fisheries begin along the N.W. coast of Norway, generally in the winter; consequently the fish would seem to commence arriving all about the same time, and though each school does not follow the identical course of the one preceding it, they may be imagined as coming in numerous parallel lines, and in a north-easterly direction from the great deep towards the shore. The chief fisheries are in the middle of the winter or first four months of the year, and about the same time as the great spring herring-fisheries. It was observed that near Christmas unusual numbers of small fishes appear on the banks off the N.W. of Norway, and before long the cod-fish make their appearance; soon the other and smaller forms decrease in number, until at last it appears as if only cod were present. The first comers (species doubtful) are termed the "announcing fish" by the fishermen, as they are the advanced guard of the large army which begins to appear about the middle of January, and continues arriving in schools consisting of milters and spawners until the middle of March—in other years they may even commence arriving as late as March, the period varying with the weather, as they come in earlier when it is mild with a south-westerly wind, than when it is cold with

* At Lowestoft a hump-backed person is frequently termed "a lord," according to Mr. Gurney.

† Edward (Zool. 1882, p. 23) mentions one from Banffshire that he considered a dorse, *Gadus callarias*, and in which there were D. 19/20/21, A. 21/20.

north-easterly gales. During a good season they are described as forming "mountains of fish," but frequently none can be captured at this period, either with seines or lines: the fishermen say they keep quiet until a new school arrives and drives them forward, their quiescence being probably due to the coldness of the water as compared with that at the depths from which they have left. They are found to keep nearest the bottom in coldest weather, while the fishermen, at least in certain localities where the current is not too strong, use floats to keep their nets or lines some distance from the ground; consequently such lines as are suspended at both ends only have the central portion reaching the bottom, while the remainder gradually approaches the surface, and thus cod are taken at often twenty or thirty fathoms from the ground. On leaving the coast of Norway they seem either to go direct out to sea or along the western shores, their course appearing to depend considerably upon the temperature of the water. They consume small fish, as the young of their own kind or any they can obtain, but are especially partial to sand-eels, herrings, sprats, and the spawn of herrings; also crustaceous and testaceous animals, and, as is well known to fishermen, evidently preferring one sort of animal food to another, being very partial to crabs and whelks, while their digestion is so powerful that the greater portion of the shells they swallow are dissolved. They often disgorge their food when hooked, and being drawn on board. In the North Sea they frequently feed at night time on the herrings meshed in the drift-nets, doing much damage to the light cotton nets. While off Devonshire and Cornwall they feast extensively upon pilchards during the autumnal migration. The contents of their stomachs are almost infinite: from one captured in Lynn Deeps on Midsummer-eve, 1626, and brought to the Vice-Chancellor of Cambridge, was taken a book in three treatises; from another, Captain Hill recovered his keys several days after he had dropped them overboard from a North Sea trawler very many miles distant from where they had been lost. An entire partridge was taken from the stomach of one. Johnston observed that a fisherman caught a cod having a hare in its stomach; while another had a white turnip. Mr. Reid, of Wick, saw a black guillemot in perfect feather removed from the stomach of one of these fishes in March, 1879; while Mr. Grove took a piece of tallow candle seven inches long from the inside of a cod. Stones and similar indigestible substances are frequently found in their digestive cavities, and which have probably been swallowed in order to obtain the corallines which were attached to them: it subsequently rejects the stones, &c. Couch observed six picked dog-fishes, each nine inches long, removed from inside another: while he records the following crustacea taken from examples captured in the west portion of the British Channel: Crabs—*Stenorynchus phalagium*, *Achæus Cranchii*, *Inachus Dorsetensis*, *I. dorynchus*, *I. leptochirus*, *Hyas coarctatus*, *Eurynome aspera*, *Xantho tuberculata*, *Cancer pagurus*, *Portunus corrugatus*, *P. arcuatus*, *P. marmoreus*, *P. pusillus*, *P. longiceps*, *Gonoplax angulatus*, *Atelecyclus heterodon*, *Corystes cassivelaunus*, *Pagurus Bernhardus*. Long-tailed crustaceans of the lobster kind—*Galathæa squamifera*, *G. strigosa*, *G. dispersa*, *G. Andrewsii*, *Munida Rondeletii*, *Gebia stellata*, *G. deltura*, *Nika edulis*, *N. Couchii*, *Squilla Desmarestii*, *Alpheus ruber*, *Scyllarus arctus*. A Norway lobster, *Nephrops Norwegicus*, has been found in one from the Scotch coast. Examining a considerable number of stomachs removed from cod-fishes taken on the east coast of England during the winter of 1880-81, whelks and crabs, especially *Hyas coarctatus*, appeared to have formed their principal food. Sharks, dog-fishes, seals, &c., are found preying on them, and sea-birds and larger fishes on their young. Thompson (Depths of the Sea) observes upon having dredged over the Faroe Bank at a depth of from 200 to 50 fathoms; the bottom gravel and nullipore, and the temperature from 8 deg. to 10 deg. C. The banks swarmed with the common brittle star (*Opliathaix fragilis*), with the Norway lobster (*Nephrops Norwegicus*), large spider-crabs, several species of *Galathea* and many of the genus *Crangon*. So ample a supply of their favourite food readily accounted for the abundance and excellence of the cod and ling on these banks.

They may be kept in salt water-vivaria as I have already alluded to (p. 274 ante). Near North Queensferry a number of fish are kept in a salt-

water pond about 200 feet long and 5 fathoms deep, in which the tide ebbs and flows twice a day. All the fish appear to thrive well, especially the cod, which are found to be firmer in the flesh and thicker across the shoulders than those obtained from the Firth of Forth (Parnell). Yarrell likewise alludes to similarly formed vivaria as existent in the Orkneys and in Fife.

*Means of capture.**—Along our coasts most of the fishing for cod is carried on by means of long- or hand-lines, although a few of the fishes may occasionally be netted, as is extensively done off Norway. The principal English fishery is off the Dogger Bank, between England and Denmark, and on Cromer Knoll on the Norfolk coast, where long-lining is engaged in throughout the winter until about April in the former locality and February in the latter. Many vessels early in the year proceed to Newfoundland, where the season extends from February until April. Off Wick, this fishing, which is largely carried on during February, is considered to terminate upon March 15th. It would fill up too much space to follow out our cod-fisheries here, but it may be remarked that some are taken throughout the year around our coasts, and during the summer it is not unusual for wanderers to come close in shore, and be captured in the bag nets set for salmon.

Bait.—It is very voracious, devouring everything eatable. Mussel are most used in Moray Firth, or the Limpet (*Patella*), also "Badgers," a common shell-fish, *Lutraria vulgaris*, and the "spout-fish," *Solen siliqua*, are very killing, but more especially the "sand launce" and "herring."

The "cod murderer" in use at Peterhead consists of a long piece of lead, either round or flat, with snoods passed through holes at intervals, bearing a hook at either end without bait. The cod strikes against the lead, and one or other of the hooks generally secures it (Angler's Note-book, p. 48).

Breeding.—The cod arrives from the deep sea, and commences spawning in our seas, usually in January, and continues this operation until April. In the Firth of Forth, however, Parnell observed that they begin to deposit their spawn in the months of May or June, and it must be remarked that they are much later in cold and boisterous seasons than in calm and mild ones. They are very prolific: Leuwenbeck counted 9,384,000 eggs in one of medium size: Harmer, 3,686,760 in one taken at the end of December: Buckland, 1,800,000 in an $11\frac{1}{2}$ lb. fish in March, while he found in $7\frac{3}{4}$ lb. of cod roe, 6,867,000, and such a quantity sometimes exists, that from fish of 21 lb. weight, 12 lb. of roe have been removed. Off Norway, Sars observed that at the spawning period the cod became restless, the males and females swimming about very rapidly, while spawning was continued some months, during which period the fish get out of condition. The females as a rule were nearer to the surface than the males, as proved by netting, for the drag nets almost exclusively took males, whereas the floating nets secured females. The ova was found to float on the sea, unless the specific gravity of the latter was altered by the admixture of rain or river water, as well as on the death of the embryo, when they sank. The egg floats, due to containing a fine globule of oil, while its heaviest part is where the micropyle exists, and which is consequently turned downwards or towards the ascending milt. Hatching occurred on the 18th day, while in America it was found to take place between the 13th and 50th days, according to the heat of the

* As showing the productiveness of these fisheries, those of Norway closed in May, 1881. The total yield of this season's fishery has been estimated as amounting to twenty-five millions and three quarters of cod-fish (of which number twenty-one and a half millions have been salted), 48,000 tons or barrels of liver, 2500 barrels medicinal train oil, and 31,000 barrels of roe. Outside the island stations the fishing yielded five millions of cod-fish (600,000 of which have been salted), 11,700 barrels of liver, seventy tons of medicinal train oil, and six thousand tons of roe. Of the smaller fisheries, which have also closed, the two principal fishing stations have produced: the one near Sondmore 160,000 vog (18 kilogrammes each) of codfish, 5000 tons of roe, 2200 barrels of medicinal and 1800 tons of other kinds of train oil; the other station near Romsdal, 600,000 cod-fish, 450 barrels of medicinal and 200 tons of common train oil, and 600 tons of roe. In June it was observed that the Arctic cod-fishing this year has proved a failure. Five of the fishing vessels from North Faroe have returned to Shetland with takes ranging from only 2000 to 4000 cod. One vessel, the *Walrus*, is reported to have 7000, the highest take of the fleet; a second trip will probably be made later in the season.

water. The floating eggs and fry are liable to be blown in shore, or destroyed by the action of wind and waves.

Life history.—The young fish, according to Sars's investigations, at first or before the umbilical bag has become absorbed, are most helpless beings, floating on the surface and tossed about by winds and waves. As soon as this sac is absorbed they seek deeper water, where the sea is more quiescent, feeding upon small transparent crustaceans, as "herring food," *Calamus finmarchicus* and *Temora longicornis*. By the end of the summer, and when about an inch in length, they go more inshore, first seeking shelter each under a medusa, *Cyanea capillata*, where they appear to feed upon the minute animals which constitute the food of this Discophora, and which are stupified by its numerous poisonous threads stretching out in all directions. As a return the young cod-fish consumes a small parasitic crustacean, *Hyperia*, which clings to the medusa by aid of its sharp claws, and even eats deeply into its jelly-like body. These young fish have also been observed floating about beneath the harmless disk-shaped *Medusa aurita*, or secreting themselves beneath sea-weeds or other floating substances. Having left the medusæ, they roam about for some time near the coast, but being pursued by sea-birds and other fishes, they seek a more stationary mode of life near the coast, where, however, young pollack have generally previously established themselves. As they grow in size they migrate into deeper water, and at the age of one year they are known as Algæ fish by the fishermen, because they resort to sandy localities among the algæ near the outer coast, at a depth of twenty or thirty fathoms. These very young are of all different shades of colour, from bright red or yellow, if residing among the *Laminaria*, to a bright green or gray if in more open or sandy places. The very young cod-fish are genuine ground feeders. Respecting the rapidity with which these fish increase in size opinions are divided, but at the Southport Aquarium, some of 3/4 of a lb. in weight, increased in about sixteen months to 6 or 7 lb. each (Jackson).

Hermaphrodites—have been recorded by Yarrell (Proc. Zool. Soc. 1845, p. 91) and Dr. J. Smith (Proc. Roy. Phy. Soc. Edin. 1864-65, p. 300 and vol. iv, 1870, p. 256).

Diseases.—I have already alluded to affections of the spinal column, blindness and parasites in the cod (page 274 ante). When out of season they are tormented with sea-lice, while the *Lernea branchialis* is often found attached to the gills. When hooked, the borer or myxine, having obtained entrance through its mouth or gill openings, will almost devour its interior, leaving little but the skin remaining. Off the Shetland sand-banks a sessile-eyed crustacean, locally termed "bees," *Æga tridens*, has been observed to behave in the same manner among fish hooked on the long-lines, so that when the fish is hauled up it looks as plump and round as a live fish, only when opened it is found to be full of "bees," and nothing else (J. Anderson). I may here mention as one of the causes of destruction of these fishes, that large quantities of the roe is collected and sold, being employed in France and Northern Spain as bait for the sardine fisheries.

Uses.—From the air-bladder or sounds isinglass may be manufactured. The tongue whether fresh or salted is a great delicacy, while from its liver is prepared an oil, first employed as medicine in this country by Dr. Percival in 1782. Irrespective of the foregoing, we are told that the Norwegians give the head along with marine plants to their cows, for the purpose of increasing the yield of milk.* Icelanders feed their cattle with its bones, as the inhabitants of Kamtchatka do their dogs, while after being well dried they are employed as fuel along the shores of the Arctic Ocean.

As food.—The cod of our seas is in the best season from October to the beginning of February (according to Parnell in the Firth of Forth till the end of April), and in its greatest perfection about Christmas, while those of a medium size are most preferred for the table. It has been observed that such as possess the deepest groove along the back of the head, the largest belly, roundest form especially near the tail and sides, and appearing as if they were ribbed, are the best for the table. In Cornwall, those out of season, and recognizable by their

* Off the western coast of India shark's flesh is supposed to possess this property.

lanky form, are sure to be wooly and watery, and are locally known as "Churchyard cod" and may be seen exposed for sale as early as the month of March. In Norfolk it was formerly considered that the finest supplied to the market were those sent from Sherringham, which were usually found to have been feeding on crabs (Gurney).

Modes of cooking.—Rutty observed that in his time (1772) the Fitzgallian fishermen made a broth at sea from the cod and haddock, which they thickened with the liver of the cod bruised to a paste, and incorporated with the broth. When fresh the head and shoulders are boiled and served with oyster sauce and melted butter: or the body may be similarly treated, or it may be stewed. Slices of the fish may be fried, and are improved by some curried gravy being added. Salt fish may likewise be boiled, also salted cod's sound, while the last are sometimes fried in butter.

Cod can be preserved in salt, and remain good for eating a much longer period than any other form of the family. For curing, as observed by Bertram, the fish should be used as soon as possible after capture: they are split along their entire length, and well washed until all the blood is removed. A part of the backbone having been cut away, they are drained and then laid in long vats, covered with salt, and weighted down in order to keep them well under the pickle. After a time they are removed, drained, washed, and brushed to prevent the collection of impurities. Then they are bleached by being individually spread out in the open air. This accomplished, they are collected into heaps termed *steeples.* When the *bloom* or whitish appearance shows itself, the process is complete and they are ready for the market. In the trade the salted cod-fish brought from Norway and elsewhere are roughly divided into *flat* or *klip*, and *rund* or *stock-fish*: the first form being salted and subsequently dried, and the second simply dried without the use of salt.

Habitat.—In the northern seas of Europe and America from about the 67° to the 50° of latitudes, for such as are found north or south of these limits are either few in quantity or inferior in quality; except perhaps along the N.W. coast of Norway, where, due to the presence of a warm gulf stream, it may be taken a little further to the north: while those present in Greenland are small, emaciated, and voracious. It extends principally from the south and west coasts of Iceland and the shores of the Scandinavian Peninsula, through the North Sea and coasts of the British Isles to those of France. While it is most abundant off Newfoundland, where a mud bank more than 100 leagues long and 60 broad exists buried in the ocean at from 60 to 100 feet or more below the surface.

In the Orkneys it is said to swarm around the coast, but Low remarked that in his time the fishery had become abandoned, and they were little sought after: they are likewise very abundant in Zetland (W. Baikie), and are taken all round our coasts; but in decreasing numbers as we proceed southwards. It is abundant in the sea around the islands to the north and west of Scotland; has been locally remarked upon as present at Wick (Reid): along the coast of Banff (Edward): Aberdeen (Sim). In the Moray Firth in all seasons, but most plentiful in March. St. Andrew's common (McIntosh). Firth of Forth all the year round (Parnell). Yorkshire abundant; codlings are taken plentifully inshore, and ascend the estuary of the Humber as far as Goole (Yorkshire Vertebrata). From Lincolnshire and Norfolk to the mouth of the Thames (Yarrell): Devonshire coast not so common or good as those from the N. or N.E. coast (Parfitt). In Cornwall common all round on sandy banks and rough ground in sheltered bays (R. Couch), but rarely in good condition for the table. In Ireland common around the coast.

The example figured was from the mouth of the Thames, and $10\frac{1}{2}$ inches in length. The largest Pennant heard of from our coasts weighed 78 lb., it was 5 feet 8 inches long, and captured at Scarborough in 1755, and sold for one shilling: their usual weight in Yorkshire he gave at from 14 to 40 lb. Thompson records two taken on the same day in Belfast Bay which weighed 56 and 60 lb. respectively. Yarrell, one of 60 lb. taken in the Bristol Channel, and produced five shillings.

2. Gadus æglefinus, Plate LXXIX.

Æglefinus, tertia asellorum species, Bel. pp. 126, 127. *Tertia asellorum species*, Rondel. ix, c. 11, p. 277; Gesner, pp. 26, 100; Aldrov. iii, c. 1, p. 282. *Onos*, Willughby, p. 170, t. L. M. i, no. 2; Ray, p. 55. *Asellus minor*, Schonev. p. 18. *Gadus*, sp. p. 64, Synon. p. 36, no. 7, Genera, p. 20, no. 5; Gronov. Zooph. no. 320, and Mus. i, no. 59. *Anos sive asinus antiquorum*, Rutty, Dublin, ii, p. 354. *L'anon*, Duhamel, Pêches, ii, Sec. 1, c. 4, p. 133, pl. xxiii, f. 1. *Callarias*, sp. Klein, Pisc. Miss. v, p. 6, no. 2. *Isa*, Olafs, Isl. Reise § 528, t. xxvi. *Haddock*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 179 (Ed. 1812) iii, p. 241. *The Haddock*, Low, Faun. Orcad. p. 192.

Gadus æglefinus, Linn. Syst. Nat. i, p. 435; Bl. Fische Deuts. ii, p. 188, t. lxii; Gmel. Linn. p. 1159; Bonnaterre, Atl. Ich. p. 46, pl. xxviii, f. 99; Shaw, Zool. iv, p. 136; Lacép. ii, p. 397; Bl. Schn. p. 6; Donovan, Brit. Fish. iii, pl. lix; Mitchell, Lit. and Phil. Trans. New York, i, p. 370; Turton, Brit. Fauna, p. 89; Jenyns, Manual, p. 441; Fries and Ekstr. Skand. Fisk. p. 86, t. xix; Faber, Fische Isl. p. 100; Nilss. Skand. Fauna, iv, p. 550; Kröyer, Dan. Fiske, i, p. 42, c. fig.; Malmg. Spets. Fisk. Fauna, p. 529, and Wiegm. Arch. 1864, p. 297; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Thompson, Nat. Hist. Ireland, iv, p. 179; Johnston, Berwick. Nat. F. Club, 1838, i, p. 173; McIntosh, Fish. N. Uist. Pro. R. Soc. Edin. v, 1862-66, p. 614, and Fish. St. Andrew's, p. 178; Gronov. ed. Gray, p. 131; Günther, Catal. iv, p. 332; Schlegel, Dieren Neder. p. 80, pl. vii, f. 2; Collett, Norges Fiske, p. 108; Gilpin, Proc. and Trans. Nov. Scot. Inst. N. Hist. ii, pt. i, p. 100; Winther, Ich. Dan. Mar. p. 28; Moreau, Poiss. France, iii, p. 237.

Morhua æglefinus, Flem. Brit. An. p. 191; Yarrell, Brit. Fish. (Ed. 1) ii, p. 153, c. fig. (Ed. 2) ii, p. 233 (Ed. 3) i, p. 536; Parnell, Wern. Mem. vii, p. 337, and Fish. Firth of Forth, p. 177; Storer, Fish. Mass. p. 124; DeKay, New York Fauna, Fish. p. 279, pl. xliii, f. 138; White, Catal. Fish. p. 88.

Melanogrammus æglefinus, Gill, Proc. Ac. Nat. Sc. Phil. 1862, p. 280.

Æglefinus Linnei, Malm, p. 481.

Haddock, Couch, Fish. Brit. Isles, iii, p. 62, pl. cxxxvi.

B. vii, D. 14-16/20-24/19-21, P. 19-20, V. 6, A. 24-25/20-22, C. 25, Vert. 23/31.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, of caudal fin 5, height of body $4\frac{1}{4}$ to even 6 in the total length. *Eye*—diameters $3\frac{1}{2}$ to 4 in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and 2/3 of a diameter apart. Interorbital space flat: snout rounded and somewhat projecting over the mouth: the upper jaw rather longer than the lower: the posterior extremity of the maxilla reaches to nearly or quite beneath the anterior edge of the eye. A short barbel situated beneath the chin. *Teeth*—cardiform in the jaws, the outer row in the upper jaw somewhat enlarged. *Fins*—the first dorsal, somewhat triangular in shape, commences over the base of the pectoral, its second or third ray the longest and slightly exceeding the extent of the base of the fin, its posterior rays very short: a short but distinct interspace between the first and second dorsal fins, the third or fourth ray of which last about equals half the length of its base, its last rays minute: the third dorsal fin is not continuous at its base with the second, it is similar to the second anal and not connected with the caudal. The first anal fin commences below or slightly behind the origin of the second dorsal, and is similar to it. Caudal emarginate. Ventral pointed and inserted on a line anterior to the base of the pectoral, which latter fin is pointed and as long as the head excluding the snout. *Scales*—fine but distinct over the body. *Lateral-line*—follows the curve of the back from the upper edge of the opercle, curving gradually downwards below the second dorsal fin, and is continued to the middle of the base of the caudal. Vent situated beneath the origin of the second dorsal fin, or in some few instances a little in advance of this spot. Cœcal appendages not so numerous as in the common cod. *Colours*—grayish in the upper half of the body, light on the sides and white beneath. A large oval black blotch exists on the side between the middle or posterior half of the pectoral fin and the lateral-line, being sometimes

continued above it. Lateral-line of a deep black. Fins bluish-black, being darkest externally.

Superstition has handed down the tradition that the black blotch on either shoulder of this fish is due to the action of St. Peter's finger and thumb when he drew out one of the haddock's ancestors from the Lake of Genneserat to obtain the piece of tribute-money. Unfortunately, neither this fish nor the John Doree, which has been equally honoured (see p. 140), are to be found in the waters where the miracle was reported to have occurred.

Varieties in form.—Shortened forms occasionally exist among haddocks as remarked upon respecting the common cod, and due to the same cause or disease of the vertebral column. In *colour* several variaties have been recorded. Thompson saw one about eighteen inches long from Belfast market of a beautiful rich salmon-colour in its upper half, becoming lighter on the sides and abdomen: this tint was also observable on all the fins with the exception of the extremity of the caudal, which was dusky. The finger-spot was faint. Another example, captured off the entrance to Strangford Lough, was of a pale golden yellow superiorly, and white below the lateral-line, which instead of being black was white: no finger-spot was visible. Dr. Ball obtained a large canary-coloured example in Dublin, and another small specimen of a light rose-red. In the month of February, at Belfast, Thompson's attention was called to a large haddock in fine condition which was clouded over the sides with an extremely pale stone-colour, apparently as if the skin had been taken off; but this was the natural colour as all the scales were on. Couch would class all these Irish specimens as *Dorse.*

Names.—*Haddock*, formerly spelt *hadock*, which in Scotland is pronounced *hathock* or *haddie*, and which after spawning are termed *gamrels* or *camrels:* when about five inches long, *nockies* (Sim, Aberdeen). This fish has likewise other local names as *buckthorn*, which is mostly applied to dried haddock; *mop*, and *whiting-mop*, also *mulvel* (Halliwell). In the Moray Firth it is termed *adag* or *attac* (Gordon): in the Firth of Forth they are *finnan haddocks*, when smoked in a peculiar manner: if simply dried *speldrings*, and are eaten raw (Parnell). Belonius states that *Egrefin* or *Eagle-fin* was formerly its English name. *De Schelvisch*, Dutch. *Le gade égrefin*, French.

Habit.—Haddocks congregate in enormous numbers, feed near the ground and for their size are as voracious as the cod, but the two forms do not seem to be usually found together. They are abundant off our shores, especially those of the eastern counties, the finest and greatest numbers being taken during the winter months, for after spawning the largest retire, leaving the smaller ones behind. Pennant observed that off Yorkshire large schools usually arrive near the shores in December, and instances the coincidence that in 1766 and 1777 they came both years on the 10th, the shoals being nearly three miles in breadth, while they extended in length from Flamborough to Tinmouth Castle, and perhaps much further to the north. They will frequent some rocky ground for many seasons, and from some cause suddenly leave it for a new situation, perhaps due to exhaustion of the food.* "Fishermen assert that in rough weather haddocks sink down into the sand and ooze at the bottom of the sea, and shelter themselves there till the storm is over; because in stormy weather they take none, and those that are taken immediately after a storm are covered with mud on their backs" (Pen.). Their food varies with locality. Thompson in Belfast found they mostly contained the remains of *Ophiuræ*, especially the spines of *O. rosula*, the presence of which is considered by Dr. Drummond as one reason why these fishes are found so free from intestinal worms. During summer they live on young herrings and other small fish: in the winter on the stone-coated worms (*Serpula*) which fishermen call haddock-meat. They consume great quantities of herring ova and fry, while the sprat is likewise favourite food.

In the Phil. Trans. Royal Soc. 1792, pp. 367-373, is an account of a remarkable failure of these fishes in Northumberland.

* Mr. Dunn observes that off Mevagissey large ones, up to 12 lb. weight, were plentiful about fifteen years ago in about 30 fathoms of water, but in 1870 entirely left the coast, where they are almost a rare fish.

Means of capture.—Line or beam-trawl fishing as it generally feeds near the ground. Off Norfolk long lines for haddock fishing, the length of each of which is about 370 fathoms, are locally termed schulls. In the Moray Firth it is taken throughout the year, except during the six or eight weeks of the herring fishery; but in stormy weather it refuses all baits. Pennant (1776) observed that three fishermen within one mile of Scarborough harbour frequently loaded their coble or boat with them twice a day, taking each time about a ton of fish: when they shot their lines upwards of three miles from the shore they took nothing but dog-fishes, which showed the limits to which they resorted for feeding. The best sold at 1*s* to 1*s* 6*d* the score, and the smaller ones at a penny and sometimes a halfpenny a score. When the surface of the sea in the Arctic regions is covered with ice these fishes congregate in the crevices which separate the ice. The inhabitants take advantage of this, and by constantly breaking the ice produce crevices which answer their purpose, and here they draw out the haddocks with their hands. Seals likewise use these crevices for fishing from; Arctic foxes are said to also join in their destruction.

Baits.—Cuttle, mussels of both the horse-and edible-species, sprats, and cod bait.

Breeding.—In America a haddock of $2\frac{2}{8}$ lb. gave 169,050 eggs, the number increasing in quantity until from one $9\frac{9}{16}$ lb. 1,839,581 were taken: the shortest time required for hatching was eight and the average nine days. Pennant observes that they spawn in January. Some are certainly in full roe during February and March, during which latter month R. Couch observed that they spawned in Cornwall; and Parnell that they did so in the Firth of Forth. Sars remarked that the spawning process of this fish is very similar to that of the cod, and in the Loffoden Islands it takes place about the same time. Off Cape Ann in America the number of males were observed to be more abundant than the females, but the latter averaged a larger size.

Life history.—Sars observed the young in the sea off Loffoden Islands concealing themselves under medusæ similarly to the cod (see page 281).

Uses.—Haddocks taken by line are far superior, their flesh being much firmer than those captured by the beam trawl, in which they are bruised and generally have their scales rubbed off. But the trawl-haddocks are by no means wasted as food, the head being cut off and with the intestines used for manure. They are then split and smoked, and sold as smoked haddocks. Haddocks will not take salt so well as cod. In the neighbourhood of Walworth and Kennington there are several curing-houses. The fish are bought by the costermongers in Billingsgate market in the morning, pickled, skewered, hung up in the smoke of sawdust by the evening, and when sufficiently tinged a yellow colour they are fit for sale. A skilled curer can clean, salt, and smoke a load of haddock in from six to eight hours. Those from Finnan, near Aberdeen, have obtained a great reputation. All at first were smoked over a peat-reek, but the demand becoming very great they were cured in special buildings erected for the purpose and smoked in large numbers over burning fir branches or burning sawdust.

As food.—The small ones, not sufficiently old to breed, are extremely good from May until February, and some few even so late as April; but the flesh of the larger ones is often dry and hard, still up to two or three pounds in weight it is a good table fish for midwinter. It is in the best season from November until February, while in the Irish markets the larger the haddock the more it is generally prized. The quality of its flesh differs in accordance with the waters it inhabits. "Among the East Friezelanders, where the sea is very muddy and shallow, it is thought to be so unwholesome as to excite fever: but with us it is very good food and may vie with the cod," the best being taken off the Irish coast.

Diseases.—In the record into the state of the salmon fisheries in 1825, it appears from the Parliamentary report that about thirty years previously so great was the havoc among these fish that ships had sailed through many leagues of the North Sea where the surface was covered with dead haddocks, and for several subsequent years it was a rare fish in those localities. Mr. Hood (Land and Water, March 22nd, 1869) observes having some years previously paid a visit to Dagenham Reach in Essex, and having noticed not very far from where

he was standing some rooks that appeared to be feeding at the edge of the water. On reaching the spot he saw a large haddock of about four pounds weight nearly dead, without eyes, which the rooks had pecked out. Further on were other haddocks without their eyes, some were quite dead and others nearly so. On making inquiries of the keeper, he stated that those haddocks came out of the Thames into that brackish water to spawn at that time of the year, and that after they had spawned they were so weak and feeble that they lay on the surface, and the wind gradually wafted them to the shore. The rooks took advantage of this, and attacked them.

Habitat.—From the Arctic portion of Europe, having a range very similar to the cod. In February and March it appears to be most abundant off the shores of Northern Europe, while in the autumn it is usually plentiful off Holland, East Friezeland and Heligoland. It is found in varying numbers round the British Isles, and along the Atlantic shores of France. In the western hemisphere it extends from Newfoundland to Cape Hatteras. Although the haddock is common in Orkney and Zetland (W. Baikie) it is not so numerous as the cod, nor are they caught in any quantities (Low); their visit would seem to be short. Wick (Reid): Banffshire extensively taken and largely cured (Edward): Aberdeen (Sim), and more numerous along the eastern coasts of Scotland and England (especially from the Tyne to Yarmouth) than along their western: in Yorkshire resident and very abundant (Yorkshire Vertebrata): common in the Norfolk estuary (Lowe): also along the south coast of England.

In Ireland it is generally common around the coast, but varies in different localities. Dublin Bay is famous for its haddock, while those of Belfast are highly esteemed. At Portrush, Co. Antrim, Ogilby (Zool. 1876, p. 4904) observes that on Nov. 7th a haddock was captured, a great prize, as none had been obtained for the last ten years, the fish having quite deserted the ground where they were formerly very numerous. However, on opening it it was found to be diseased and black inside.

The example figured is 10 inches in length. Respecting the size to which this fish attains, one weighing $10\frac{3}{4}$ lb. was landed in February, 1878, at Wick: another was taken in Dublin Bay which weighed $24\frac{1}{4}$ lb. and was 37 inches in length. The largest haddock mentioned by Yarrell was 16 lb., from Dublin Bay; by Couch 25 lb., and Thompson one of the same size from Groomsport.

3. **Gadus luscus,** Plate LXXX.

Asellus luscus, Willughby, p. 169. *Asellus mollis latus*, Willugh. Append. p. 22, t. L. M. i, no. 4; Rutty, Dublin, i, p. 355. *Asellus luscus* and *A. mollis latus*, Ray, p. 55. *Gadus*, sp. Artedi, Spec. no. 6, p. 65, Synon. p. 37, no. 12, and p. 35, no. 5, Genera, p. 21, no. 6; Gronov. Zooph. no. 320. *Callarias*, Klein, Pisc. Miss. v, p. 6, no. 3. *Pout* and *Bib*, Pennant, Brit. Zool. (Ed. 1776) iii, pp. 183, 184, pl. xxx (Ed. 1812) iii, pp. 246, 247, pl. xxxiv. *Tacaud*, Duhamel, Pêches, ii, p. 136, pl. xxiii, f. 2.

Gadus luscus, Linn. Mus. Ad. Frid. ii, p. 60, and Syst. Nat. i, p. 437; Gmel. Linn. p. 1163; Bonn. Atl. Ich. p. 47, pl. xxix, f. 102; Shaw, Zool. iv, p. 140; Donovan, Brit. Fish. i, pl. xix; Turton, Brit. Fauna, p. 90; Jenyns, Manual, p. 442; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Johnston, Berwick. Nat. Club, 1838, i, p. 173; Nilss. Skand. Fauna, iv, p. 545; Kröyer, Dan. Fiske, ii, p. 77, c. fig.; Thompson, Nat. Hist. Ireland, iv, p. 181; H. Blake-Knox, Zool. 1866, p. 507; Günther, Catal. iv, p. 335; Schlegel, Dieren Neder. p. 81, pl. viii, f. 1; Giglioli, Pesc. Ital. p. 36; Moreau, Poiss. France, iii, p. 233.

Gadus barbatus, pt. Linn. Syst. Nat. i, p. 437; Bloch, t. clxvi; Bl. Schn. p. 7; Shaw, Zool. iv, p. 139; Turton, Brit. Fauna, p. 90; Cuv. Règne Anim.; Malm, Götheb. Hand. 1851, p. 107, c. fig.

Gadus tacaud and *bibus*, Lacép. ii, pp. 365, 366, 403, 410.

Morhua lusca, Flem. Brit. Anim. p. 191; Yarrell, Brit. Fish. (Ed. 1) ii, p. 157, c. fig. (Ed. 2) ii, p. 237 (Ed. 3) i, p. 540; Parnell, Wern. Mem. vii, p. 340, and Fish. Firth of Forth, p. 180; Thompson, Nat. Hist. Ireland, iv, p. 181; White, Catal. Fish. p. 88.

Morhua barbata, Fleming, Brit. Anim. p. 191.
Gadus colias, Gronov. ed. Gray, p. 131.
Gadulus luscus, Malm, p. 482.
Bib, Couch, Fish. Brit. Isles, iii, p. 70, pl. cxxxviii.

B. vii, 12/20-23/19-20, P. 17, V. 6, A. 27-32/17-20, C. 25, Vert. 48.

Length of head $4\frac{1}{2}$ to $4\frac{2}{3}$, of caudal fin $6\frac{1}{2}$, height of body $3\frac{1}{2}$ to 4 in the total length. *Eye*—diameters 3 to $3\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and 1 to $1\frac{1}{4}$ diameters apart. Snout obtuse, scarcely overhanging the jaws, the upper of which is slightly the longer. The posterior extremity of the maxilla reaches to beneath the middle of the eye. A barbel as long as the eye is present below the chin. *Teeth*—cardiform in the jaws with an outer enlarged row in the upper. *Fins*—first dorsal fin elevated, it arises over the base of the pectoral, its second or third rays longest, and equalling two-thirds the height of the body beneath it, its last rays short: and no interspace between it and the second dorsal fin, the second and third rays of which exceed in height twice the length of the base of the fin which is connected at its base with the third dorsal, which does not extend to the base of the caudal fin. The first anal fin commences beneath the middle or posterior third of the first dorsal, and terminates opposite the end of the second dorsal: the second anal fin similar to the third dorsal. The ventral is inserted on the throat some little distance anterior to the base of the pectoral, which latter fin is as long as the head excluding the snout. Caudal square at its extremity or slightly emarginate. Vent situated beneath the anterior portion of the first dorsal fin. *Cœcal appendages* numerous. *Scales*—small. *Lateral-line*—curves very gently to below the last half of the second dorsal, from whence it proceeds straight to the centre of the base of the caudal fin. *Colours*—of a beautiful bronze during life, with five or six broad vertical bands of rather darker colour descending from the back to the lower surface, meeting those from the opposite side. A black spot at the base of the pectoral fin. Fins bluish-black, darkest at their outer edges.

It has been observed respecting the ribs of this fish that they are well developed and firmly attached to the parapophyses of the vertebræ, while from the sixteenth of the latter they commence to join the ribs from the other side, thus enclosing the posterior portion of the abdominal cavity with a series of complete rings.

Varieties.—The origin of *Gadus luscus* and *G. barbatus* rests, as pointed out by Jenyns, on an error of Ray, who was Willughby's editor. The latter author described the *bib* or *blinds* of Cornwall as *Asellus luscus*. After the body of the work had been printed, Martin Lister sent to Ray a *whiting pout* from the London market. Not suspecting the two fish belonged to one species he inserted the latter in the appendix, and also gave the two as distinct in his Synopsis Piscium—errors perpetuated by subsequent authors.

Names.—*Bib*, *pout*, *whiting-pout*, *blens* or *blinds* in Cornwall, these last names are doubtless due to a sort of loose bag capable of inflation existing in front of the eye, and formed by an outer layer passing from the cheeks over the eye, and a second layer over the eye-ball, thus forming a sac-like cavity, well designated by the local words *bleb* or *blain*, terms for a bubble in the water, or a blister. After death this loose membrane, which fishermen assert it can blow up at pleasure, may become opaque. For the same cause it is perhaps termed *lug*, or "a leaf," at Penzance and St. Ives; *bothock*, or "large eyes." Said to be known at Scarborough by fishdealers as "John Doree" (see page 140); at Whitby as "old wife" (see page 255) (Yorkshire Vertebrata): also *kleg* at Scarborough: *siller-fish* and *Jackie-downies*, Moray Firth: *smeltie*, Zetland; also *brassie*, in Scotland. It is likewise said to be "Miller's thumb" (see *Cottus gobio*, p. 48) or *deillion* at Carnarvon (Fleming). Also *bragay* and *stink-alive* (Buckland). *De steenbolk*, Dutch. *De gade tacaud*, French.

Habits.—It adheres pertinaciously to one spot, according to Mr. Dunn, who observes that it is largest and in the best condition when residing among rocks upon precipitous coasts as Cornwall. Here it seeks a secluded crevice or gully where it conceals itself during the day time, sometimes thousands seeking the

same spot. At twilight it sallies out, as it usually feeds only at night time, extending its excursions over the high grounds and on to the low rocks and sands beyond, but not going very far. Assemblages of these fish are known as "chains of bibs," two or more of which may be found so close together as to be merely divided by a ledge of rock of a few feet in width; one chain of bibs may be light coloured and the contiguous one banded with dark. In mild winters it remains in these haunts, but if cold and stormy it retires to the deep sea, returning again in spring. It also appears partial to living inside wrecked vessels. It prefers rough ground or shelving rocks arising from a sandy soil. The knowledge of the exact localities where these fish reside has been kept in some fishermen's families for generations. It thrives pretty well in an aquarium, but after a time becomes of a lighter colour. Thompson mentions finding small crabs (*Brachyuri*) and a *Trochus tumidus* in the stomach of one which he opened; while another contained fish remains, it also eats worms.

Means of capture.—Line fishing, they are very voracious, and the exact spot they reside in has to be chosen and the line must be near the bottom, while on it 3 or 4 hooks may be used.

Baits.—In Dublin Bay it takes best on a sunny afternoon at low water, when other fish refuse to bite, and refuses no bait (Blake-Knox).

Breeding.—Spawns towards the end of the winter in Cornwall.

As food.—Good eating when two pounds in weight or upwards, but its numerous bones deteriorate from its use. It rapidly decomposes after death, which likewise detracts from its value.

Habitat.—From Scandinavia along the Atlantic coasts of Great Britain and Europe, but is only a wanderer into the Mediterranean; but stragglers have been taken as far as Italy. Occurs in Zetland (W. Baikie): Banffshire common, but is mostly used for bait (Edward): Aberdeen (Sim): not uncommon at St. Andrew's (McIntosh), and found in Berwickshire (Johnston): also reported as not uncommon in Yorkshire (Yorkshire Vertebrata): occurs off Norfolk (Yarrell), the Sussex coast, and becomes very common along the Devonshire coast (Parfitt), and numerous in Cornwall, especially during the autumn and winter. Yarrell alludes to its presence in Carnarvonshire as well as in Loch Foyle.

In Ireland, according to Thompson, of occasional occurrence, but on all quarters of the coast: and examples occur at all seasons of the year in the Belfast market, where he observes the females are termed *hen-fish* and *crow-fish* in Galway Bay. Knox-Blake observes of the Dublin coast that it is one of the commonest fish: in Kingstown Harbour the fry are often caught on a hook and line in scores, up to 4 lb. weight.

The example figured is 9 inches long, and from the coast of Sussex: it seldom exceeds a foot in length, but Yarrell mentions having seen one 16 inches.

4. Gadus minutus, Plate LXXXI.

Anthiæ secunda species, Rondel. vi, c. 12, p. 191, c. fig.; Gesner, pp. 56, 64. *Asellus mollis minor*, Will. p. 171; Ray, p. 56. *Asellus mollis minimus*, Ray, p. 163, f. 6. *Gadus*, sp. Artedi, Synon. p. 36, no. 8, Genera, p. 21, no. 7. *Poor* or *Power cod-fish*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 185, pl. xxx (Ed. 1812) iii, p. 249, pl. xxxiv.

Gadus minutus, Linn. Syst. Nat. i, p. 438; Gmel. Linn. p. 1164; Bonn. Atl. Ich. p. 47, pl. xxix, f. 104; Shaw, Zool. iv, p. 141 (? Bloch, Fische Deuts. ii, p. 167, t. lxvii, f. 1; Bl. Schn. p. 7); Turton, p. 90; Jenyns, p. 444; Fries och Ekstr. Skand. Fisk. p. 78, t. xvii; Retz. Fauna Suec. p. 319; Nilss. Skand. Faun. iv, p. 547; Thompson, P. Z. S. 1837, p. 57, and Nat. Hist. Ireland, iv, p. 181; Günther, Catal. iv, p. 335; Steind. Ich. Span. u. Port. 1868, p. 38; McIntosh, Fish. St. Andrew's, p. 178; Collett, Norges Fiske, p. 109; Winther, Ich. Dan. Mar. p. 29; Giglioli, Pesc. Ital. p. 36; Moreau, Poisson France, iii, p. 231.

Gadus luscus, Bl. Schn. p. 8, tab. ii.

Gadus capelanus, Lacép. ii, p. 411; Risso, Ich. Nice, p. 111.

Morua capelanus, Risso, Eur. Mérid. iii, p. 226.

Morhua minuta, Flem. p. 191; Yarrell, Brit. Fish. (Ed. 1) ii, p. 161, c. fig. (Ed. 2) ii, p. 241 (Ed. 3) i, p. 544; White, Catal. p. 89.

? *Morhua minuta*, Storer, Fish. Mass. p. 127; De Kay, New York Fauna, Fish. p. 277, pl. xliv, f. 141.

Brachygradus minutus, Gill, Proc. Ac. Nat. Sc. Phil. 1862, p. 280.

Gadulus minutus, Malm, p. 484.

Power, Couch, Fish. Brit. Isles, iii, p. 72, pl. cxxxix.

B. vii, D. 12-15/19-25/17-22, P. 13-16, V. 6, A. 25-29/17-24, C. 26.

Length of head $4\frac{1}{4}$ to $4\frac{3}{4}$, of caudal fin $6\frac{1}{2}$, height of body $4\frac{1}{4}$ to $4\frac{3}{4}$ in the total length. *Eye*—diameters 3 to $3\frac{1}{2}$ in the length of the head, 3/4 of a diameter from the end of the snout, and 1 to $1\frac{1}{2}$ apart. Snout obtuse. Jaws of about the same length anteriorly, the maxilla reaches posteriorly to beneath the middle of the eye: the snout rather overhangs the upper jaw. Barbel on the chin, but scarcely so long as the orbit. *Teeth*—cardiform, with an enlarged outer row in the upper jaw. *Fins*—the first dorsal commences above the root of the pectoral, its height equals two-thirds of that of the body, the last ray short and connected with the base of the second dorsal, the second and third rays of which equal two-fifths of the length of the base of the fin, it is connected at its base with the third dorsal, which does not extend on to the caudal. Anal commences below the last rays of the first dorsal and is continued to opposite the end of the second dorsal. Second anal similar to the third dorsal. Caudal slightly forked or emarginate. Ventral inserted some little distance before the base of the pectoral, its two outer rays elongated. Pectoral rather above half the length of the head. *Scales*—small, about ninety rows. *Lateral-line*—very slightly bent, becoming straight beneath the second third of the second dorsal fin. Vent situated below the last rays of the first dorsal fin. *Colours*—greenish or gray along the back, becoming lighter on the sides and beneath, in some large examples there exists a trace of gray at the base of the pectoral fin.

Winther places *G. luscus* as a variety of this fish, but *G. minutus* is not nearly so deep in the body, while its vent is placed below the last rays of the first dorsal fin, and the free portion of its tail is more extended. I have not had the opportunity of investigating both sexes of these two species of fish.

Names.—*Power* or *poor-cod*. *Skelchie* or *skelach*, Aberdeen (Sim). *Ribben-pout*, Cornwall. *Le gade capelan*, French.

Habits.—If the bib and the power inhabit the same ledge of rock, they are said not to mingle, while the latter species keeps to the lower level in smaller schools, are not so constant to one locality but are mostly found on a hard bottom. Thompson observes that most of his Irish examples have been captured on a soft oozy bottom, and some in the middle and deepest part of Belfast Bay. They live on small crustaceous animals. In the Baltic they are said to be the forerunner of the haddock and larger species of the cod family. Thompson has chiefly found crustacea in their stomachs: in one was a full grown *Pagurus bernhardus*, and fragments of marine plants have also occurred.

Means of capture.—Line-fishing. They frequently obtain access into crab-pots: also trawling near rocky ground which they frequent.

Baits.—The same as for the bib.

Uses.—As bait. Of no value as food.

Habitat.—From Scandinavia along the Atlantic and North Sea coasts of Great Britain and Europe, very common in the Mediterranean: said by Pennant to be sometimes a nuisance at Marseilles as on its arrival other fishes disappear. Orkney and Zetland, two specimens obtained in Kirkwall in August, 1851 (W. Baikie): Banffshire small and scarce (Edward): Moray Firth abundant (G. Harris, Zool. 1854, p. 4261): Aberdeen (Sim): St. Andrew's common (McIntosh), but not mentioned by Parnell from the Firth of Forth: on the Devonshire coast frequently taken with the hook and in crab-pots (Montagu). Coast of Sussex along the southern shores to Cornwall, where it is common.

In Ireland it has been obtained on the N.E., the S. and the W. coasts. Thompson received three captured in Sept. 1835, in Belfast Bay, all being less than four inches in length. He obtained another in Belfast market in Feb. 1836, and in fact, as he observes, "The species is permanently resident on the shores

of Ireland, evinced by my obtaining them at all seasons of the year. On the coasts of Down and Antrim they are chiefly taken in our sheltered bays, where I have no doubt they breed."

For the one figured, life size, I am indebted to C. Jackson, Esq., Honorary Director of the Southport Aquarium. The largest I have obtained, $8\frac{1}{2}$ inches in length, came from the coast of Sussex.

b. No barbel below chin.

5. Gadus merlangus, Plate LXXXII.

Secunda asellorum species, Rondel. ix, c. 10, p. 276; Gesner, pp. 85, 99. *Asellus candidus primus*, Schonev. p. 17. *Asellus minor alter*, Aldrov. iii, c. 3, p. 287. *Asellus mollis major*, Willughby, p. 170, t. L. M. i, no. 5; Rutty, Dublin, i, p. 355; Ray, Syn. p. 55. *Gadus*, p. Artedi, Syn. sp. 34, no. 1, Spec. p. 62, no. 1, Genera, p. 19, no. 1; Gronov. Zooph. no. 316. *Blege*, Ström, Söndm. i, p. 270. *Callarias*, Klein, Pisc. Miss. v, p. 8, no. 3, t. iii, f. 2. *Whiting*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 190 (Ed. 1812) iii, p. 255; Low, Fauna Orcad. p. 197; *Merlan*, Duhamel, Pêches, ii, Sect. i, p. 128, pl. xxii, f. 1.

Gadus merlangus, Linn. Syst. Nat. i, p. 438; Bloch, Fische Deuts. ii, p. 161, t. lxv; Bonn. Atl. Ich. p. 48, pl. xxix, f. 105; Gmel. Linn. p. 1167; Shaw, Zool. iv, p. 144; Lacép. ii, p. 424; Bl. Schn. p. 9; Donovan, Brit. Fishes, ii, p. 36; Turton, Brit. Fauna, p. 91; Faber, Fische Isl. p. 93; Fries and Eks. Skand. Fische, p. 81, t. xviii; Cuv. Règne Anim. Ill. Poiss. pl. cvi, f. 2; Nilsson, Skand. Fauna, iv, p. 553; Kröyer, Dan. Fiske, ii, p. 83, c. fig.; Gronov. ed. Gray, p. 132; Günther, Catal. iv, p. 334; Schlegel, Dieren Neder. p. 75, pl. viii, f. 2; Steind. Ich. Span. u. Port, 1868, p. 37; Collett, Norges Fiske, p. 108; McIntosh, Fish. St. Andrew's, p. 178; Winther, Ich. Dan. Mar. p. 29; Moreau, Poiss. France, iii, p. 239.

Merlangus vulgaris, Fleming, Brit. Anim. p. 195; Jenyns, Manual, p. 445; Yarrell, Brit. Fishes (Ed. 1) ii, p. 166, c. fig. (Ed. 2) ii, p. 244 (Ed. 3) i, p. 548; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Swainson, Fishes, ii, p. 300; Johnston, Berwick. Nat. Club, 1838, i, p. 173; Parnell, Wern. Mem. vii, p. 342, and Fish. Firth of Forth, p. 182; Thompson, Natural Hist. Ireland, iv, p. 182; White, Catal. p. 90.

Merlangus linnei, Malm, p. 485.

Whiting, Couch, Fish. Brit. Isles, iii, p. 74, pl. cxl.

B. vii, D. 13-16/18-23/19-21, P. 19, V. 6, A. 30-35/20-24, C. 28, Vert. 23/31.

Length of head 4 to $4\frac{1}{4}$, of caudal fin $6\frac{1}{2}$, height of body $5\frac{1}{4}$ to 6 in the total length. *Eye*—diameters 4 to $4\frac{1}{2}$ in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and 3/4 to 1 diameter apart. Interorbital space nearly flat. Snout conical, slightly projecting over the upper jaw, which latter is a little longer anteriorly than the mandible: the maxilla reaches posteriorly to beneath the middle of the eye. A row of from six to eight pores is present along the lower surface of the mandible. No barbel beneath the chin. *Teeth*—cardiform, with some larger ones intermixed in the lower jaw, the outer row enlarged in the upper jaw, in a semilunar patch upon the vomer, none on the palatines or tongue. *Fins*—first dorsal somewhat triangular, it commences opposite the first third of the pectoral, its second and third rays the longest, equalling the length of the base of the fin, the last ray very short. A short interspace between the bases of the first and second dorsal fins, the third ray the longest, and equal to about half the length of the base of the fin. A short interspace between the second and third dorsal fins, which latter does not quite reach the base of the caudal. First anal fin commences beneath the middle of the first dorsal fin and terminates beneath the end of the second dorsal: the second anal and third dorsal fins similar. Caudal with a square or slightly emarginate extremity. Ventrals inserted on the throat some little distance before the base of the pectoral, which latter rather exceeds half the length of the head. *Scales*—small and cycloid.

Lateral-line—commences opposite the upper edge of the opercle, and curves gently downwards, from opposite the anterior half of the second dorsal it goes direct to the centre of the base of the caudal. The vent is situated beneath the middle of the first dorsal fin. *Colours*—back greenish gray or yellowish, becoming silvery on the sides and beneath; in the fresh state several yellow lines pass along the sides. A bluish-black blotch exists in the axil of the pectoral fin. Vertical fins dark in their outer two-thirds.

Varieties—in colour.—The axillary spot is occasionally little marked or even entirely absent.

Names.—*Whiting* pronounced *fittin* in Scotland. *Cuideag* pronounced *cuitschach* in the Moray Firth (Gordon). *Whiting-mop*, "a young whiting" (Halliwell). At Aberdeen those found in June and July are termed *dargs* (Sim). *De Wijting*, Dutch. *Le merlan commun*, French.

Habits.—It appears in the spring in large shoals, and though delighting in sandy bays where young fish abound, it seems to be shy, and mostly keeps from half a mile to three miles from the shore, in spring time hanging about the more distant rocks: even during the warm summer months it often keeps two or three miles from the coast. In Cornwall it swarms into the bays in autumn to feed on yonng pilchards which are from 3 to 4 inches long. It appears to be very susceptible to the influence of cold, thus Couch gives an instance how numbers were off the Cornish coast during the month of February, the largest being full of roe, when the wind changed to the north, and the thermometer fell from 47° to 44°, and notwithstanding the weather continued moderate, all the adult fish at once retired to deeper water. In the Moray Firth it is said to be most abundant in May and June, but in the best condition during November and December (Gordon). It is a voracious feeder, subsisting on small fish, crustacea, and any animal substances it can obtain. Yarrell took several sprats from inside one, and Couch some pilchards. Mr. Gosden found in one a female broad-tailed lobster, *Scylurus arctus.*

Means of capture.—Whiffing when it gives good sport, especially during rough weather: it is likewise taken by the trawl. It bites best early in the morning or in the evening. It will rise by moonlight into midwater after its prey.

Baits.—Common mussels, a slice of the herring or cuttle, but it generally prefers living prey.

Breeding.—It spawns in March not far from the shore.

Hermaphrodites have been recorded by Yarrell (Pro. Zool. Soc. 1845, p. 91).

As food.—It is much esteemed, more so perhaps than any other species of the genus, being very easy of digestion. It is in the best condition from November, not being so deleteriously affected by breeding as the other gadoids, therefore eaten throughout the year, but being somewhat out of condition during April, May and June, invalids should avoid them, as they are apt to occasion nausea and even vomiting. It has to be disembowelled prior to being transmitted to inland markets or it rapidly decomposes, and is best when eaten immediately after being captured. Whiting may be fried, filletted, boiled or baked. A considerable portion of these fish are salted or dried when the takes are in excess of the demand. Small ones salted and dried are termed *buckorn* from Dartmouth to Cornwall.

Habitat.—Off Scandinavia and in the northern seas, the German Ocean, and along the Atlantic coasts of Europe to the Mediterranean, where it is likewise widely distributed, if *Gadus euxinus* is the same species as suggested by Steindachner (Sitz. Ab. Wiss. Wien. 1868, lvii, p. 703).

It is distributed around the British shores, but the largest quantities are obtained off the south coast, especially in the vicinity of Plymouth, while very fine ones from 2 lb. to 3 lb. each are got from Dartmouth. In the Orkneys Low observed upon having seen this species caught once or twice, but he concluded that it could scarcely bear the rough gusts of the winter seas, being a delicate fish. When haddock are caught in any quantities, whiting are taken in numbers. Orkney and Zetland not common (Baikie): at Banff often captured, but not so

good as the haddock (Edward): Aberdeen (Sim): frequent at St. Andrew's (McIntosh): Firth of Forth plentiful (Parnell): resident and very abundant off Yorkshire (Yorkshire vertebrata): plentiful in the Norfolk estuary, especially in the autumn, but those on the Norfolk coast only attain to about two-thirds the size of those off Devonshire: common along the south coast of England, and very abundant off Devonshire and Cornwall, especially in the latter county, from September until March, the largest and best coming from Polperro (Cornish).

In Ireland it is common around the coast, but not held in much estimation in the north. It is considered in its finest season in the spring.

This fish has been recorded off the British coasts up to 16 inches in length and from 3 to 4 lb. in weight, but Couch remarks on having heard of one weighing 7 lb., while Pennant records fish from 4 lb. to 8 lb. weight, taken from the edge of the Dogger Bank.

B.—*Lower jaw the longer: its outer row of teeth enlarged* (*Boreogadus*).

6. Gadus poutassou, Plate LXXXIII, fig. 1.

Gadus merlangus, Risso, Ich. Nice, p. 115 (not Bloch).

Merlangus poutassou, Risso, Eur. Merid. iii, p. 227.

Merlangus albus, Yarrell, Brit. Fish. (Ed. 2) ii, p. 247, c. fig. (Ed. 3) i, p. 551; Couch, Zool. 1847, p. 1824; White, Catal. p. 90; Van Beneden, Bull. Acad. Sc. Belg. 1865, xx, p. 52; Andrews, Proc. Nat. Hist. Dublin, 1865, iv, p. 9; Steind. Ich. Span. u. Port. 1868, p. 39.

Gadus potassoa, Düben. Vet. Akad. Handl. 1844, p. 88.

Pollachius poutassou, Bonap. Pesc. Eur. 45.

Gadus melanostomus, Nilss. Skand. Faun. iv, p. 556.

Kulmund, Esmark, Naturg. Möte i Christ. 1844, p. 230.

Merlangus communis, Costa, Faun. Napol.: Canestr. Fauna Ital. p. 154.

Merlangus vernalis, Canestr. Arch. Zool. 1863, t. ii, p. 352.

Gadus poutassou, Günther, Catal. iv, p. 338; McAndrew, Fish. N. Uist, Pro. Nat. Hist. Soc. Dublin, 1864, p. 9; Collett, Norges Fiske, p. 110; Winther, Ich. Dan. Mar. p. 30; Giglioli, Pesc. Ital. p. 36.

Merlangus poutassou, Moreau, Pois. France, iii, p. 255, c. fig.

Poutassou, Couch, Fish. Brit. Isles, iii, p. 77, pl. cxli.

Boreogadus poutassou, Malm, p. 486.

B. vii, D. 12-13/12-14/22-24, P. 20, V. 6, A. 34-38/20-25, C. 25-29, Vert. 53 (Couch).

Length of head $4\frac{1}{4}$ to $4\frac{3}{4}$, of caudal fin 6, height of body 6 to 7 in the total length. *Eye*—diameters $3\frac{3}{4}$ in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and 2/3 of a diameter apart. Lower jaw slightly the longer: the maxilla reaches posteriorly to beneath the middle of the eye: the snout does not overhang the upper jaw. Barbel on chin absent. *Teeth*—an outer row of distantly placed enlarged ones in the jaws, and one or two rather large ones present in the vomer on either side. *Fins*—the first dorsal commences above the middle of the pectoral, anteriorly it is one-fourth higher than its base is long. The interspace between the first and second dorsal fins equals half the length of the base of the latter. The second dorsal fin is not quite so high as the first, but higher than the third. The interspace between the second and third dorsal fins equals nearly twice the length of the base of the second dorsal. Anal commences below the origin of the first dorsal: the second anal is below and similar to the third dorsal. Caudal deeply emarginate. Pectoral as long as the head behind the middle of the eye. Ventral very short, scarcely exceeding the diameter of the eye. *Scales*—very small. *Lateral-line*—nearly straight, situated parallel with the back in the upper fourth of the height of the body. Vent situated a little before the commencement of the anal fin, and therefore anterior to a vertical line descending from the insertion of the first dorsal fin. *Colours*—brownish along the back, divided by a yellow band from the

lateral-line, one or more yellow longitudinal bands parallel with and below the lateral-line. A small black spot in the axil of the pectoral fin, which is sometimes absent, especially in the young. Dorsal and caudal fins gray becoming nearly black externally: anal fins light, the base may even be white with the outer edge gray. Pectoral brown.

Names.—*Couch's whiting.*

Habits.—Risso observes it is taken at all seasons off Nice, and that it frequents deep water.

Baits.—Similar to those for whiting.

Breeding.—It is said to spawn in spring off Nice. Couch observed in July, 1861, a number of the young of about five inches in length; they continued about three weeks, and between the 21st and 23rd of July suddenly disappeared.

As food.—Its flesh is of a good taste but soft, and rapidly decomposes.

Habitat.—From Scandinavia to the coasts of Belgium and Great Britain: also the Mediterranean, where it is common, and is taken at Nice throughout the year, but becomes rare in the Italian seas.

It has been taken off North Uist in the Hebrides, and is occasionally found in Ireland (McAndrew): in May, 1840, Mr. Couch obtained an example of it at Polperro, 15 inches in length: another was subsequently taken by a fisherman in the same place (R. Couch).

"In June, 1861, our bays were full of the young of this species. In 1871, if possible, they were in greater quantities, some shoals covering acres of sea-water, these leaping over each other in hungry haste to devour the young herrings which were plentiful in the sea" (Dunn). The same observer wrote to me from Mevagissey on May 8th, 1881, that the poutassous had come. "Some fishermen report them crowding around their boats in the offing, as they did in 1871," but unfortunately none were captured, being too small to be taken in the nets which were being employed.

For the use of the example figured, life size, I have to thank Professor Peters, Director of the Zoological Museum in Berlin. He obtained it upwards of twenty years since in the fish-market at Christiansund.

C.—*Lower jaw the longer: teeth in upper jaw of equal size. Pollachius.*

b. No barbel below chin.

7. Gadus virens, Plate LXXXIV.

Piscis colfish Anglorum, Belon. De Aquat. p. 133; Gesner, p. 89. *Asellus niger carbonarius*, Schonev. p. 19; Aldrov. iii, c. 7, p. 289; Willughby, p. 168, t. L. M. 1, no. 3; Ray, p. 54. *Gadus*, sp. Artedi, Synon. p. 34, no. 2, Genera, p. 20, no. 2; Gronov. Zooph. no. 317, 318. *Callarias imberbis*, no. 2, Klein, Pisc. Miss. v, p. 8. *Coal-fish*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 186, pl. xxxi (Ed. 1812) iii, p. 250, pl. xxxv; Low, Fauna Orcad. p. 193. *Greenland cod*, Pennant, l. c. (Ed. 1812) iii, p. 253. *Colin*, Duhamel, Poiss. ii, p. 125, t. xxi, f. 1; Ascan. Icon. iii, t. xxiii. *Asellus niger*, Rutty, Dublin, 1772, i, p. 354. *Green cod*, Pennant, l. c. (Ed. 1812) iii, p. 253.

Gadus virens, Linn. Syst. Nat. i, p. 438, Fauna Suec. p. 112; Bl. Schn. p. 6; Bonnat. Atl. Ich. p. 48; Gmel. Linn. p. 1166; Shaw, iv, p. 149; Nilss. Skand. Fauna, Fisk. iv, p. 559; Günther, Catal. iii, p. 339; Steind. Ich. Span. u. Port. 1868, p. 41; McIntosh, Fish. St. Andrew's, p. 178; Collett, Norges Fiske, p. 111; Winther, Ich. Dan. Mar. p. 31.

Gadus carbonarius, Linn. Syst. Nat. i, p. 438; Bl. Fische Deuts. ii, p. 164; Bl. Schn. p. 9; Bonnat. Atl. Ich. p. 48, pl. xxix, f. 106; Gmel. Linn. p. 1168; Donovan, Brit. Fish. i, pl. xiii; Shaw, Zool. iv, p. 145; Turton, Brit. Fauna, p. 91; Richards. Faun. Bor.-Amer. Fish. p. 247; Faber, Fische Isl. p. 96; Brandt and Ratzeb. i, p. 51, t. ix, f. 1; Fries and Ekstr. Skand. Fisk. p. 195, t. xlviii; Gronov. ed. Gray, p. 132; Giglioli, Pesc. Ital. p. 36.

Gadus colinus (adult), and *sey* (young), Lacép. ii, pp. 416, 417.

Merlangus virens, Flem. Brit. Anim. p. 195; Jenyns, Man. p. 447; Yarrell, Brit. Fish. (Ed. 1) ii, p. 175, c. fig. (Ed. 2) ii, p. 256 (Ed. 3) i, p. 557; Parnell, Wern. Mem. vii, p. 349, Fish. Firth of Forth, p. 189; Thompson, Nat. Hist. Ireland, iv, p. 184; Reinh. in Dansk. Vid. Selsk. Afhandl. vii, p. 128.

Merlangus carbonarius, Flem. Brit. Anim. p. 195; Jenyns, Man. p. 446; Yarrell, Brit. Fish. (Ed. 1) ii, p. 169, c. fig. (Ed. 2) ii, p. 250 (Ed. 3) i, p. 554; Parnell, Wern. Mem. vii, p. 345, and Fish. Firth of Forth, p. 185; Storer, Fish. Massach. p. 129; De Kay, New York Fauna, Fish. p. 287, pl. xlv, f. 144; Johnston, Berwick. Nat. Hist. Club, 1838, i, p. 173; Kröyer, Dan. Fiske, ii, p. 102, c. fig.; Thompson, Nat. Hist. Ireland, iv, p. 183; Gronov. ed. Gray, p. 132; White, Catal. p. 90; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Edin. v, 1862-66, p. 614; Schlegel, Dieren Neder. p. 72, vii, f. 3; Moreau, Poiss. France, iii, p. 243.

Gadus pollachius, Gronov. ed. Gray, p. 133.

Pollachius carbonarius (Bonap.) Gill, Fish. N. E. Coast America, 1860, p. 48.

Pollachius virens, Malm, p. 488.

Coalfish and *green pollack*, Couch, Fish. Brit. Isles, iii, pp. 84, 87, pl. cxliii, cxliv.

B. vii, D. 12-14/19-22/20-22, P. 19, V. 6, A. 24-27/20-23, C. 36, Vert. 34.

Length of head $4\frac{1}{4}$ to $4\frac{3}{4}$, of caudal fin 6, height of body $4\frac{1}{4}$ to $4\frac{3}{4}$ in the total length. *Eye*—diameters $3\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and 2/3 to 1 diameter apart. Lower jaw prominent. The maxilla reaches to below the first third of the eye. A rudimentary barbel beneath the chin. *Teeth*—cardiform in the jaws, present on the vomer, absent from the palatines and tongue. *Fins*—the first dorsal triangular, its third ray the longest and equals the extent of its base: a distinct interspace between the first and second dorsal fins, the highest ray of which last equals half the length of its base: an interspace between the second and third dorsal fins, the latter not extending on to the caudal. Anal commences below the last rays of the first dorsal and terminates below the end of the second dorsal: second anal similar to the second dorsal. Ventral on the throat inserted anterior to the base of the pectoral, which rather exceeds half the length of the head. Caudal slightly forked or truncated. Vent situated on a vertical line beneath the last rays of the first dorsal fin. *Colours*—superiorly gray, becoming silvery on the sides and beneath. Fins gray, the dorsal and caudal dark-edged. Usually a black spot at the axil of the pectoral fins by which it is mostly concealed. As they get older the dark colour deepens. Lateral-line white, which at once distinguishes it from the haddock where it is black.

Varieties.—Thompson mentions receiving a specimen 7 inches long, in May, 1836, at Ballywalter, which seemed intermediate between the *G. pollachius* and *G. virens*, both of which he obtained at the same time and place. The lateral-line was parallel to the dorsal profile: jaws equal, but snout slightly projecting: caudal fin more forked than in *G. pollachius*. D. 15/20/21, A. 25/20, P. 20, V. 6, C. 36. Colour much the same as in *G. virens:* lateral-line whitish. Couch remarks on one which had the upper jaw shortened, and the body depressed out of the regular straight shape. The first dorsal fin was more narrow, lofty, and sharper than normal, having its origin nearer to the head: an interspace existed between it and the second dorsal, and a still more extensive interspace between the second and the third. Three anal fins: the first an irregular triangle, the second very narrow, and a considerable curved interspace between it and the third. The vent was much behind its usual position. The fish was thin and ill-fed. Pennant refers to examples from the German Ocean none of which exceeded 7 inches in length, which were said to have possessed no barbel, and the two jaws were of equal extent anteriorly.

Names.—*Coal-fish*, so termed from its occasional black colour, it being called *cole-fish* by Ray, *col* signifying charcoal, not due to its producing isinglass or *ichthyocolla*, as believed by Belonius, from its English name of *colfisch*. Another derivation of the term *cole-fish* has been found in the corruption of the French name "colin." *Sillocks*, Scotland, and *blue-backs*, Yorkshire: *rauning* (ravenous)

pollack, Cornwall: also locally as *baddock*, *bil*, *billet*, *billard*, *black pollack*, *black-jack*, *bleck*, *coalsay*, *coalsey*, *coal-whiting*, *colemie*, *colmey*, *cooth*, *cudden*, *cuddy*, *dargie*, *gilpin*, *glassock*, *glashan*, *glossan*, *glossin*, *green-cod*, *green-pollack*, *gray-lord*, *gull-fish*, *harbine*, *kuth*, *lob*, *lob-keeling*, *moulrush*, *piltock*, *podlie*, *podling*, *prinkle*, *rock-salmon*, *saithe*. *sethe*, *sey-pollack*, *sillock*, *skrae-fish*, *stenloch*, *tibrie*. The fry are called *parrs* at Scarborough as well as in Northumberland, and *soil*, *poodler*, *billets* or *billiards* up to one year of age: *cuddies*, *saithes*, *coalman*, also *saidhean*, or *suyeen* (Moray Firth): and *gerrocks* at Banff: *herring-hake* at Aberdeen.

In *Ireland* its names are legion. In county Down it possesses four: the fry are *gilpins*, next size *blockan*, then *graylord*, while the adults are termed *glashan*. The young in some localities are also called *cudden* or *pickey*. In some parts of the south and west these fish are termed *black-pollack* or *glassin*. At Roundstone the young are called *glossan* and *moulroush*, while adults are termed *coalfish*: at Portrush the fry are about early in the spring, and by the time they are from four to seven inches in length they are known as *cadan* (pronounced *cudden*): next spring they are called *ceithnach* (pronounced *catenach*), perhaps an expansion of the last name, since the termination *ach* signifies "like." In the following autumn, when weighing about 2 lb., they are known as *glasan* (pronounced *glashin*) in allusion to their green colour, and a year later *two-year-old glasan*. Subsequently they are entitled to the full term *gray-lord*, as when they are from 8 lb. to 25 lb. weight.

De koolvisch, Dutch. *Le merlan noir* ou *colin*, French.

Habits.—Generally gregarious, especially when pursuing herring to which form of food they appear very partial. In the Orkneys the fry are first seen in May, when they are taken in large numbers by angling; but it is in the winter, when the sea begins to get stormy, that the large shoals appear. At this period they are from six to ten inches in length, and much esteemed as *sillucks*, about March they retire to the deep and grow rapidly, so that by May they are 15 inches long and termed *kuths*, which are tolerable for eating either fresh or roasted with the liver, or even dry. A few are taken in the second year, when they are called *two-year-old kuths* or *harbines*, and are now very coarse and not sought after. Subsequently they attain to a vast bulk, and are then termed *seths*, but are rare (Low). Dr. Drummond gives an account of once finding his boat in the midst of a shoal of these fishes when at play. The whole sea was alive, while they were disporting themselves in all attitudes. They were regardless of the boat, and so intent on their gambols that numbers were captured with an instrument like a boat hook. Mr. Dunn has remarked the same phenomena, but he ascertained that it was due to their chasing small fishes. During the smooth season of the year the coal fish approaches the shore and moves quietly about, but when it descries any prey it pounces on its victim with great violence. Thompson mentions finding principally small crustaceans as *Idotea*, &c. in the stomachs of these fish: Dr. Drummond usually observed that they were gorged with *Onisci*, and very fond of *Entomostraca*. Mr. Ffennell saw twenty-six salmon fry taken from the stomach of one of these fishes.

Means of capture.—Angling, which is often done from shore, and line-fishing, the lug-worm being found a good bait. They are very voracious and have great strength. In Belfast Bay a few large examples are occasionally taken in the mullet nets during the spring of the year.

Breeding.—In America, where they appear to commence spawning off Cape Ann about the end of November, it was found that a coal-fish 39½ inches long had 4,029,200 eggs, and one seven inches shorter 2,569,753, and that they seem to spawn while swimming about, when their eggs being buoyant are found on the surface. They would appear to hatch in four or five days in water of moderate temperature. In Cornwall they spawn in the spring: in the Orkneys small fry are seen in June (and in July off Yorkshire) in vast shoals, wherein each fish is about 1½ inches in length: by August they have attained to from 3 to 5 inches, when they are angled for.

Uses.—Low remarked "as things are at present with us, this species is the treasure of the Orkneys: while these are to be found, none else are regarded,"

but he suggests they encourage laziness, as the fishermen when they are present do not trouble themselves to seek anything better. In Land and Water, a correspondent observed that an oil is prepared from their livers, but towards winter in the Shetlands they are swept ashore in enormous quantities, and are often purchased for manure. They now fall off very much in condition, and are bought in order to obtain oil, which is used for lamps. In June or July those 9 or 10 inches long are in the perfection for eating, if cooked within an hour or so of being caught; they are cooked without disembowelling, and after being rolled in salt and flour are done on the gridiron. The oil is in good demand by tanners.

As food.—Unless when small it is little esteemed when fresh, but salts well: its flesh is coarser than that of the pollack. Fishermen in Cornwall salt it for home consumption.

Habitat.—This hardy species was the only fish captured by Lord Mulgrave on the coast of Spitzbergen, while the fry 4 or 5 inches long were caught with the trawl net on the west coast of Davis' Straits during Sir E. Parry's first voyage. It is taken off the coasts of Scandinavia, and abounds in the North Sea and northern coasts of Europe and extends around Great Britain to the shores of France, and into the Mediterranean. Gill considers *Gadus purpureus*, Mitchell, and *Merlangus leptocephalus*, De Kay, as identical, or probably so with this, as the American fauna only includes one species of *Pollachius*, which extends from Greenland to Cape Hatteras. This fish has also been reported as existing in Nova Scotia (Gilpin, Proc. and Trans. Nov. Scot. Ins. Nat. Sc. ii, pt. 1, 1867).

It is common off most of our deep and rocky coasts, especially in the north: and in the Orkneys and Zetland is extremely abundant (W. Baikie): Banffshire where it is numerous, more especially the young, termed *gerrocks* (Edward): Aberdeen (Sim): abundant at St. Andrew's (McIntosh): also in the Moray Firth during the time the herrings are present. A few are taken near Newcastle-on-Tyne, but it is not much sought after, being held in little esteem (G. Rowell); in Yorkshire it is resident and very abundant (Yorkshire Vertebrata). In Norfolk estuary a large one was captured in 1845, and is now in the Wisbeach Museum: it is frequently taken in Blakeney Harbour. In Devonshire abundant in the bays and sometimes in the harbours (Parfitt). In Cornwall it is common during the winter and spring, when it appears to be gregarious and resides in strong currents, from which it shelters itself by keeping behind large rocks, from whence it darts out on its prey.

In Ireland it is one of the commonest fish around the coast, although rare in Dublin Bay (McCoy). Buckland records one 43 inches long and 25 lb. captured in December, 1866, and Thompson an example of 32 lb. weight which was taken in Belfast Bay.

8. Gadus pollachius, Plate LXXXIII, fig. 2.

Asellus huitingo-pollachius, Willughby, p. 167; *Asellus virescens*, Ray, Syn. p. 53; Rutty, Nat. Hist. Co. Dublin, 1772, i, p. 354.

Gadus, sp. Artedi, Synon. p. 35, no. 3, Genera, p. 20, no. 3. *Pollack*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 188 (Ed. 1812) iii, p. 254; Low, Fauna Orcadensis, p. 126. *Lieu*, Duhamel, ii, sect. i, cap. 2, p. 121, pl. xx, f. 1. *Callarias imberbis*, no. 1, Klein, Pisc. Miss. v, p. 8.

Gadus pollachius, Linn. Syst. Nat. i, p. 439; Bl. Fische Deuts. ii, p. 171, t. lxviii; Bonnaterre, Atl. Ich. p. 48, pl. xxx, f. 107; Gmel. Linn. p. 1169; Shaw, Zool. iv, p. 147; Lacép. ii, p. 417; Bl. Schn. p. 10; Walb. Artedi, iii, p. 127; Donovan, Brit. Fishes, i, pl. vii; Turton, Brit. Fauna, p. 91; Risso, Ich. Nice, p. 113; Fries. and Ekstr. Skand. Fisk. p. 89, t. xx; Nilss. Skand. Fauna, iv, p. 562; Gronov. ed. Gray, p. 133; Schlegel, Dieren Neder. p. 74, pl. vii, f. 4; Günther, Catal. iv, p. 338; Ogilby, Zoologist, 1876, p. 4755; Steind. Ich. Span. u. Port. 1868, p. 40; McIntosh, Fish. St. Andrew's, p. 178; Collett, Norges Fiske, p. 111; Winther, Ich. Dan. Mar. p. 30; Giglioli, Pesc. Ital. p. 36.

Merlangus pollachius, Yarrell, Brit. Fish. (Ed. 1) ii, p. 172, c. fig. (Ed. 2) ii,

p. 253 (Ed. 3) i, p. 559; Kröyer, Dan. Fiske, ii, p. 123, c. fig.; Parnell, Wern. Mem. viii, p. 347, and Fish. Firth of Forth, p. 187; Jenyns, Manual, p. 446; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Johnston, Berwick. Nat. Club, 1838, i, p. 173; Thompson, Nat. Hist. Ireland, iv, p. 183; White, Catal. p. 91; Moreau, Poiss. France, iii, p. 241.

Gadus viridis, Gronov. ed. Gray, p. 133.

Pollachius linnei, Malm, p. 487.

Pollack, Couch, Fish. Brit. Isles, iii, p. 80, pl. cxlii.

B. vii, D. 11-13/16-20/15-19, P. 19, V. 6, A. 24-31/16-21, C. 31.

Length of head $3\frac{3}{4}$ to $4\frac{1}{2}$, of caudal fin $6\frac{1}{2}$, height of body $4\frac{1}{4}$ to 5 in the total length. *Eye*—diameters 4 to 5 in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and $1\frac{1}{4}$ apart. Interorbital space flat: snout conical. Lower jaw prominent, the maxilla extending posteriorly to beneath the anterior edge of the orbit. Barbel absent. *Teeth*—villiform and of equal size in the jaws: in two small patches on the vomer, none on the palatines. *Fins*—the first dorsal commences over the middle of the pectoral, its third ray equalling the length of the base of the fin: a short interspace between it and the base of the second dorsal, and a similar interspace present between the bases of the second and third dorsal fins. The first anal fin commences under the posterior rays of the first dorsal and terminates beneath the end of the second dorsal: second anal similar to the third dorsal. Ventral inserted on the throat a short distance before the pectoral, which last rather exceeds half the length of the head. Caudal square or slightly emarginate at its extremity. *Scales*—distinct over head and body. *Lateral-line*—curves to beneath the commencement of the second dorsal fin from whence it proceeds straight to the centre of the base of the caudal fin. Vent beneath the anterior half of the first dorsal. *Air-bladder*—narrow, largest anteriorly, from its front two prolongations proceed forward, one on either side. The organ is continued through the entire length of the abdominal cavity. On its front wall, in its anterior part, are two elevated and almond-shaped muscular prominences: if the air-bladder is opened, a large dark-coloured glandular body is seen on its anterior wall in its forepart: some large vessels penetrate to it. *Colours*—the back of the fish when captured is of a dark rifle green superiorly, becoming lighter on the sides, where it usually has some golden stripes or spots, and nearly white beneath. Fins dark green, the first dorsal with three oblique bronze-coloured bands, and two longitudinal ones on the second and third, all the fins edged with dark colours, sometimes even black.

Varieties.—Ball observed an example taken in the spring of 1838, in which the rays of the first dorsal fin had grown to more than three times their normal length. Couch remarks on the young occasionally having its sides and abdomen yellow or bright orange, due, it is believed, to their residing in the shelter of rocks which are covered with ore-weed.

Names.—*Pollack: whiting-pollack: leets* (Scarborough): *laits* (Whitby): and in Scotland and some parts of the north of England *lythe*, perhaps signifying its pliancy and rapidity of movement, *laithe*, *leeat*, *leet*, *skeet*. Sometimes termed *greenling* or *green-fish*. Also termed *lythe* at Portrush, county of Antrim (Ogilby). The *lob* alluded to in the Statute of Herrings (31 Ed. III, A.D. 1537) as lob, ling, and cod evidently meant this fish, not the *Gadus virens* as suggested by Couch. The term is from the Danish word *lubbe*, which signifies the pollack. *De pollak*, Dutch. *Le merlan jaune* ou *lieu*, French.

Habits.—This species is common on many of our rocky coasts all round the country, and usually prefers being not far from land, waiting to dash upon any unwary prey that comes within reach, the largest ones being generally taken in the autumn. Low observed that in the Orkneys it is frequently close in shore among the sea-ware and in deep holes among the rocks. Mr. Dunn has remarked that off Cornwall it frequently sticks to one spot, from which it extends its range, but is not so sure of returning as is the bib, being a strong fish of a more roving disposition. Mr. Peach observed a small whiting which had taken refuge within the hollow of a medusa, *Cyanea aurita*, but was seen by a young pollack about

five inches in length, which at once gave chase. The whiting dodged round its friendly medusa, but a second pollack joined the pursuit. An unlucky movement drove the pursued one from its shelter, and an exciting chase immediately commenced. Some more pollacks joined in and like a pack of hounds ran their victim down, which they killed for sport as they did not attempt to feed upon it. So eager were the pursuers that when stones were thrown at them they showed no alarm although at other times a single stone would instil terror. Mr. Dunn has observed them springing out of the water after air bubbles made by a boat passing quickly through the sea.

Sars observed off the coast of Norway that the pollack systematically chased the young codfish. Schools of the former appeared to surround the little codfishes on all side, making the circle narrower and narrower, till all the codfish were gathered into one lump, which they then by a quick movement chased up to the surface of the water. They were now attacked on two sides, below by the pollack, above by the sea-gulls. The pollack were also observed to treat sand-eels in the same manner, surrounding a school of them, and forcing them towards the surface of the water where gulls assisted in their destruction. This fish is likewise partial to herrings.

Means of capture.—It sometimes bites keenly, gorging the bait at once, and also takes a fly, but this sport is best tried from sunset for about two hours, especially if a fresh breeze is blowing, and then it rises freely at a gaudy artificial fly, roughly made of red and white feathers, but is more choice in its selection of food than is the coal-fish. The boat should be rowed along very gently at about four or five hundred yards from the shore, or in a suitable locality, and the fly be allowed to float from twenty to thirty yards from the stern of the boat. Although the young flood or slack water is generally best for this fishing in some places, the best sport is to be had at high water. Off Plymouth it has been observed that as a rule falling water gives the best sport in the open sea, but at the points of bays special configurations of the shore and outlying rocks may alter this general rule. Pollack of small or moderate size will also come close in shore where ridges of rock jut out under a few fathoms of water. A little rain is often conducive to the success of this fishing. At different places and likewise different fishermen will praise various sorts of bait for whiffing, but live sand-eels would appear to be as good as any when procurable. A fisherman in the Field observes that failing these he finds as the two best baits a peculiar red india-rubber eel on one line, and on the other a spinner with the back of the hook dressed with prepared fish skin and a piece of the same skin on the point of the hook, for which is substituted when procurable a slice from the tail of a longnose or mackerel. But it is not always easy to tempt a pollack with bait while pilchards are about.

Baits.—Sand-eels, *Ammodytes*, are their favourite bait, or an imitation insect known as "the Belgian grub," which is modelled in plaster on to the shank of a hook and painted red and white: it is fitted with gut and a swivel. The end grub should be larger than the rest, with a piece of red india-rubber, resembling a brown elastic band, attached to the hook, and which when drawn through the water represents a wriggling sand-eel. Higher up, on two yards of salmon-gut, two or three smaller grubs may be placed without the eel and attached like bob-flies on a casting-line. At the head of the gut should be a small swivel, then four or five yards of snooding attached to a coarser hand-line, which is wound round the usual square frame as a reel. At the end of the hand-line, or at its junction with the snooding, is strung a small leaden weight of 2 or 3 oz. so that while being dragged through the water the lead may be near but not on the bottom, while the snooding and gut cast with the bait, being lighter, follow at a few feet distance above the rocks and weeds where the pollack like to frequent. The large summer pollack often refuse the "Belgian grub" and have to be tempted by live sand-eels or artificial white-flies. Cockles have been praised as a bait

* Mr. Dunn informs me that a diamond was said to have been found inside a pollack at Falmouth.

for ground fishing. On the Galway coast small fresh-water eels are said to be ingeniously fastened on to the hooks and used as a bait for the pollack.

Breeding.—It spawns about the end or early part of the year, and the young are first seen at Mevagissey in April about 1 inch long (Dunn). On May 28th, 1881, I received from Mr. Dunn some specimens captured at the surface of the sea, they were from 7/10 to 1 inch in length. Over the head and back, as seen under a microscope, were numerous small angular black spots, and elsewhere some star-shaped ones. No scales nor even ventral fins were visible until the fish had attained 4/5 of an inch in length.

As food.—In the highest perfection in the autumn, especially those from about the end of Cornwall or off the Scilly Isles: it is superior to the coal-fish. Mr. Cornish observes that it is an excellent fish all the year round, but best in winter. A fry of little pollack, about 6 inches long, will beat a similar dish of Cornish trout at any time.

It is not seen much in the London market, but appears to be eaten on the coast where taken: now and then a few are exposed for sale in the Cheltenham fish shops.

Mr. Dunn observes that porpoises will pursue both the young and full-grown pollack, and not long since the crew of a Mevagissey fishing-boat saw a school of the former attack one of the latter. After a short time full thirty large pollack were left for dead floating on the sea: they tacked their boat and picked up many of them.

Uses.—Oil is obtained from the liver off Scandinavia, where the "sey" or young pollack gives about 26½ gallons each 200 fish. Fishermen in Cornwall frequently salt and dry this fish for home consumption.

Habitat.—From the northern seas extending along the coasts of Norway to the German Ocean and European shores of the Atlantic, becoming rare in the Mediterranean. This species does not appear to have been obtained in America, where our coal-fish, *Gadus virens*, is termed the pollack.

Although frequently met with in the Orkneys and Zetland, it is not so common as most of the cod family. At Banff frequent (Edward): Aberdeen (Sim): St. Andrew's, occasionally from the deep water (McIntosh): Firth of Forth rare (Parnell). In Yorkshire it is resident and common (Yorkshire Vertebrata). At Lossiemouth examples are often taken during the summer and autumn months, especially among the coal-fish and in rocky localities. In fact it is found on most of our rocky coasts, but most abundant along the south or S.W. shores and bays, being numerous off Devonshire and Cornwall.

In Ireland it is common around the coast.

The example figured, which is 18 inches long, was from Plymouth.

It is generally seen up to 6 or 7 lb. weight: one has been recorded by Thompson of 12 lb. from Belfast, while Couch asserts that his specimen weighed 24 lb.

Genus II.—Merluccius, *Cuvier.*

Epicopus, Günther.

Branchiostegals seven: pseudobranchiæ absent. Body elongated. No barbel at the chin. Two or more rows of strong teeth in the jaws and on the vomer. Two dorsal fins and one anal: ventral with seven rays: caudal distinct. Scales rather small.

Dr. Günther (Catal. ii, p. 248) removed the Chilian *Merlus Gayi*, Guichenot, from the Gadidæ to the Acanthopterygian *Trachinidæ*, but subsequently (vol. iv, p. 346) restored it to its original family, considering that the specimen in the British Museum on which his conclusions were based, was most probably the young of the common hake.

Geographical distribution.—Northern hemispheres on both sides of the Atlantic; also on the southern portion of the west coast of South America to New Zealand.

Merluccius vulgaris, Plate LXXXV, fig. 1.

Ονος, Aristot. viii, c. 15, ix, c. 39; Athen. vii, p. 315; Ælian, ix, c. 38; Oppian, Hal. i, p. 5, and ii, p. 59. Ονος Θαλάττιος, Ælian, v, c. 20. *Marlutius*, Belon. De Aquat. p. 122; Gesner, pp. 84, 97. *Asellus*, Ovid. v, p. 131; Plin. ix, c. 16, 17; Rondel. ix, c. 9, p. 272; Salv. p. 73, c. fig. *Asellus alter*, Aldrov. iii, c. 2, p. 286. *Asellus primus*, Willugh. p. 174, t. L. M. 2, no. 1; Ray, p. 56; Rutty, Nat. Hist. co. Dublin, i, p. 355. *Gadus*, sp. Artedi, Syn. p. 36, no. 10, Genera, p. 22, no. 8; Gronov. Zooph. no. 315. *Lysing*, Ström, Söndm. i, p. 295. *Hake*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 191 (Ed. 1812) iii, p. 257. *Grand merlus*, Duhamel, Pêches, ii, sec. i, c. 7, p. 141, t. xxiv. *Kummel*, Holb. Götheb. nya Handl. v, p. 38, c. fig.; Schager. Phys. Sällsk. Tids. 1838, p. 302.

Gadus merluccius, Linn. Syst. Nat. i, p. 439; Gmel. Linn. p. 1169; Bonn. Atl. Ich. p. 49; Shaw, Zool. iv, p. 149; Fabr. Faun. Grœnl. p. 148; Bl. Ausl. Fische, ii, p. 94, t. cxliv; Lacép. ii, p. 446; Bl. Schn. p. 10; Brünn. Pisc. Mass. p. 20; Donovan, Brit. Fish. ii, pl. xxviii; Turton, Brit. Faun. p. 91; Risso, Ich. Nice, p. 122; Mitchell, Trans. Lit. and Phil. Soc. New York, i, p. 371; Schlegel, Dieren Neder. p. 76.

Gadus merlus, Risso, Ich. Nice, p. 122.

Merluccius vulgaris, Cuv. Règne Anim.; Flem. Brit. An. p. 195; Jenyns, Man. p. 447; Yarrell, Brit. Fishes (Ed. 1) ii, p. 177, c. fig. (Ed. 2) ii, p. 258 (Ed. 3) i, p. 562; Kröyer, Dan. Fiske, ii, p. 140, c. fig.; Parnell, Wern. Mem. vii, p. 350, and Fish. Firth of Forth, p. 190; Storer, Fishes Mass. p. 132; Nilss. Skan. Fauna, iv, p. 570; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Lowe, Trans. Zool. Soc. ii, p. 189, and Pro. Zool. Soc. 1843, p. 90; Johnston, Berwick. Nat. Field Club, 1838, p. 173; Thompson, Nat. Hist. Ireland, iv, p. 184; White, Catal. p. 92; Günther, Catal. iv, p. 344; Steind. Ich. Span. u. Port. 1868, p. 42; Collett, Norges Fiske, p. 114; Winther, Ich. Dan. Mar. p. 31; Moreau, Poiss. France, iii, p. 251; Giglioli, Pesc. Ital. p. 36.

Stomodon bilinearis, Mitch. Rep. Fish. New York, p. 7.

Merluccius esculentus, Risso, Eur. Mérid. iii, p. 220; Canestr. Fauna Italica, p. 156.

Merluccius argentatus, Faber, Fische Isl. p. 90; Fries and Ekstr. Skand. Fisk. p. 145, t. xxxiii; Günther, Catal. iv, p. 346.

Merluccius sinuatus, Swainson, Fishes, ii, p. 390, f. 73; Lowe, P. Z. S. 1840, p. 38, and Trans. Z. S. iii, p. 13.

Merluccius lanatus, Gronov. ed Gray, p. 130.

Epicopus Gayi, Günther, Catal. ii, p. 248 (not *Merlus Gayi*, Guichenot).

Merluccius albidus (Mitchell) De Kay, Fauna of New York Fishes, p. 280, pl. xlvi, f. 148.

Hake, Couch, Fish. Brit. Isles, iii, p. 99, pl. cxlviii.

B. vii, D. 10/36-40, P. 14, V. 7, A. 36-38, C. 22, Cœc. pyl. 1, Vert. 25/26.

Length of head $3\frac{3}{4}$ to $4\frac{1}{3}$, of caudal fin $6\frac{1}{4}$ to $6\frac{1}{2}$, height of body $6\frac{1}{4}$ to 8 in the total length. *Eye*—diameter $5\frac{1}{2}$ to 7 in the length of the head, 2 to $2\frac{1}{4}$ diameters from the end of the snout, and $1\frac{1}{2}$ to 2 apart. Head flattened above. Mouth deeply cleft: the lower jaw slightly the longer: the posterior extremity of the maxilla reaches to beneath the middle or hind edge of the orbit. No barbel below the chin. *Teeth*—large, acicular, in two rows, the inner of which is the larger, while the anterior ones are more movable than the posterior ones. In a V-shaped band on the vomer, none on the palatines or tongue. *Fins*—the first dorsal triangular, commencing above the base of the pectoral, its third ray the longest and equalling two-thirds the height of the body below it: a slight interspace between it and the base of the second dorsal, which anteriorly is less than the height of the first dorsal, while it reaches almost to the base of the caudal: its first 20 to 24 rays are of about equal height, then they increase for four or five rays and subsequently rapidly decrease, so as to occasion the last portion of the fin to form a rounded elevation. Pectoral as long as the head excluding the snout. Ventral inserted on the throat a short distance in front of the pectoral: its second ray exceeding half the length of the head. Anal commences on a vertical line beneath the third or fourth ray of the second dorsal and terminates below the end of the base of that fin. Caudal square at its extremity. A single short cœcal appendage. The vent is situated on a vertical line beneath the anterior rays of the second dorsal fin. *Scales*—rather small: some on the gill covers and upper surface of the head. *Lateral-line*—nearly straight. *Colours*—grayish along the back, becoming lighter on the sides and beneath: a purplish tint over the head and along the back. Fins dusky: base of pectoral, inner ventral rays, and anal straw-coloured. A small black spot often present at the upper part of the base of the pectoral. Inner surface of mouth and gill cavities black.

Varieties.—*Merluccius argentatus*, from Iceland, is said to have the inside of its mouth white instead of black, and the second dorsal and anal fins notched about their centres.

Names.—*The hake*, said to be sold in London as *Cornish salmon*. *Cegddu*, Welsh. It has also been termed *herring-hake; merluce*, or *sea-luce*, or *sea-pike*. *De stokvisch*, Dutch. *Le merlus ordinaire*, French.

This fish is one that has been employed in heraldry and figures in the armorial bearings of several families.

Hakes-teeth have been recorded as present in various soundings in charts of the sea; they consist mostly of a species of *Dentalium*, a shell having the popular name of "dog's teeth," and do not pertain to any fish.

Habits.—The hake is a night feeder, keeping quiet at the sea bottom at day-time. It is a bold and ravenous fish, a great wanderer, and rather uncertain in its movements, which seem to be sometimes due to its being chased by sharks, porpoises, and other voracious inhabitants of the deep. It is very fearless and will take fish out of the nets which appear alight with phosphorus, and are often entangled by their teeth in the nets. Seasons, and the presence or absence of food likewise affect the localities wherein it lives: thus during the summer it is often taken in bays, but in the winter more commonly in deep waters. It accompanies shoals of mackerel, herrings, pilchards, sprats, and anchovies, on which it feeds, and Couch alludes to seventeen of the latter having been taken from the stomach of one of these fishes. When food is scarce it will eat the sea-lice. Although present all the year round, it is in the autumn and winter months that the largest takes are made. In October during the present year (1881) the fisheries in Cornwall took more than in the preceding months, and the numbers augmented to the end of the year, besides becoming pretty plentiful off Devonshire, where during the commencement of January they occasionally are a glut in the market, but at the end of that month or in February begin to go off their feed due to spawning. In Donegal Bay hake-fishing commences in the month of September. In Devonshire and along the S.W. coast

this fish takes the place of the cod of the more northern counties. Bellamy, writing in 1839, observes that they were more abundant formerly, so that it would appear that it is gradually decreasing in numbers from some reason unknown.

Means of capture.—Line-fishing by night-time in midwater, or beam-trawling during the day at the bottom, by which latter method some are also captured throughout the year. So common are they in certain seasons that Couch mentions 4000 having been landed in one day in Mount's Bay; and on another occasion 1100 were taken by one boat in two nights.

Baits.—In some localities a slice from one of its own kind is found to be a good bait, but such as are suitable for the cod may be employed.

Breeding.—In the spring months, but may be delayed in cold seasons: thus Couch remarks that in 1837 spawning in Cornwall was not accomplished until August. In the report of the sea fisheries of England and Wales for 1879, it is observed that at Mevagissey these fish have been falling off in numbers for the last fifteen years, due it was surmised to Plymouth trawlers catching hundreds of thousands of baby hakes a foot or so long.

Uses.—Formerly it used to be salted in large quantities and exported, especially to Bilboa in Spain. In this country salted hake used to be known as "Poor John." Even now it is extensively salted by fishermen, especially for their own consumption. It is more appreciated at present than formerly, as due to the great price of fish it is being forced into the market. Cornish observed in 1878 that twenty years since *a burn*, or "burden for one person" of twenty-one fish, obtained 3*s* 6*d*, a high wholesale price in West Cornwall. Now the price is 15*s* to 20*s* a burn, and the retail 1*s* to 1*s* 6*d* each fish.

As food.—It is coarse, but at Plymouth all these slimy fishes, according to Yarrell, have the mucus first removed with hot water and a little alkali, otherwise they are spoiled. It may be cut into steaks and fried, or cooked in pies.

Habitat.—From the northern seas along the coast of Scandinavia, the German Ocean and European shores of the Atlantic to Madeira, while it is also distributed through the Mediterranean, especially along its northern shores, and into the Adriatic. It is common in Greenland, but whether it is the same species which extends to Cape Hatteras appears doubtful, as in the American Fishery reports it is recorded as *M. bilinearis*, Gill.

It is found around the British coasts, being much more numerous in some localities than in others. It is generally rare round Scotland (Fleming) but recorded as present in the Orkneys and at Zetland (W. Baikie): Banff (Edward): Aberdeen (Sim): in the Moray Firth during July and August, when it is found following the herrings (Gordon): at Musselburgh one was taken in 1836 and sent to the Edinburgh market, where it appeared to be unknown (Parnell). In Yorkshire it is resident but seldom caught: it is occasionally seen on the Dogger Bank, but becomes more plentiful towards the coast of Holland (Yorkshire Vertebrata): in February, 1847, one about 30 inches long was caught off Sherringham (Lowe, Fauna of Norfolk). It is however along the S. and S.W. coasts of England that this fish most abounds, becoming numerous in Devonshire and common in Cornwall, especially during the autumn and winter months.

In Ireland it is found all round the coast, but most common on the south. Off the coast of Waterford on the Nymph Bank there was formerly a large fishery for hake, which arrived in shoals twice yearly: in June, or the mackerel season and September, or the commencement of the herring season. In 1746, Smith, who wrote the history of the county of Waterford, complained that the fishery was declining. Thompson observed that he had been informed by Mr. Nimmo that upon the Galway coast, commonly in November, four or five men in one boat will take with hand-lines from 600 to 700: sometimes, but very rarely, 1000 are captured, but only when herrings are in the Bay. The Bay of Galway in old maps is termed the *Bay of Hakes.*

The example figured was from Plymouth, and is 14 inches in length. The fish frequently attains to 4 feet. Mr. Dunn observes that the largest he has seen was 24 lb. weight.

Genus III.—Phycis, *Bloch, Schneider.*

Enchelyopus, Bl. Schneider. *Hypsiptera*, Günther.

Branchiostegals seven : pseudobranchiæ absent. Body oblong or moderately elongated. A barbel on the chin. Small teeth on the jaws and vomer, none on the palatine bones or tongue. Two dorsal fins and a single anal : caudal distinct : ventral in the form of a single long and divided ray. Scales small. Cœcal appendages in moderate numbers.

Genus *Hypsiptera*, Günther (Catal. ii, p. 386) was first described "as a most interesting addition" to the Scombroids : subsequently (Catal. iv, p. 362) as an immature Gadoid : while Lütken observes that it is the young of a *Phycis.*

Geographical distribution.—Atlantic Ocean in the northern hemispheres of Europe and America, also German Ocean and extending into the Mediterranean.

1. Phycis blennoides, Plate LXXXV, fig. 2.

Phycis, Rondel. vi, c. 10, p. 106 ; Gesner, pp. 718, 845 ; Aldrov. i, c. 8, p. 43 ; Jonston, i, tit. 2, c. i, art. 6, t. xiv, no. 4 (not Salv.). *Forked hake*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 193, pl. xxx, f. 82 (Ed. 1812) iii, p. 259, pl. xxxv. *Greater forked beard*, Couch, Linn. Trans. xi, p. 75, and Fish. Brit. Isles.

Barbus major Cornubiensis, Jago in Ray, Syn. p. 163, f. 7.

Gadus blennoides, Brün. Ich. Mass. p. 24.

Merlu barbu, Duhamel, Pêches, ii, p. 147, pl. xxv, f. 4.

Gadus bifurcus, Walb. Art. iii, p. 137.

Gadus albidus, Gmel. Linn. p. 1171.

Phycis tinca, Bl. Schn. p. 56, t. xi.

Phycis blennoides, Bl. Schn. p. 56 ; Gmel. Linn. p. 1165 ; Bonnat. Atl. Ich. p. 48, pl. lxxxvii, f. 363 ; Risso, Eur. Mérid. iii, p. 222 ; Cuv. Règne Anim. ; Günther, Catal. iv, p. 351 ; Steind. Ich. Span. u. Port. 1868, p. 42 ; Canest. Faun. Ital. p. 156 ; Collett, Norges Fiske, p. 114, and Christ. Vid. Sels. Forh. 1879, i, p. 67 ; Winther, Ich. Dan. Mar. p. 32 ; Moreau, Poiss. France, iii, p. 264 ; Giglioli, Pesc. Ital. p. 36.

Blennius gadoides, Lacèp. ii, pp. 458, 484 ; Risso, Ich. Nice, p. 136.

Blennius phycis, Turton, Brit. Faun. p. 93 ; Shaw, Zool. iv, p. 172.

Phycis furcatus, Flem. Brit. An. p. 193 ; Kröyer, Dan. Fiske, ii, p. 214, c. fig. ; Jenyns, Man. p. 452 ; Yarrell, Brit. Fish. (Ed. 1) ii, p. 201, c. fig. (Ed. 2) ii, p. 289 (Ed. 3) i, p. 595 ; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411 ; Swainson, Fishes, ii, p. 301, c. fig. ; J. Blake-Knox, Zool. Dec. 1866, p. 508 ; Thompson, Nat. Hist. Ireland, iv, p. 187.

Phycis bifurcus, White, Catal. p. 96.

Greater fork-beard and *Blennoid fork-beard*, Couch, Fish. Brit. Isles, iii, pp. 125-128, pl. cliii, cliv.

B. vii, D. 9-10/54-62, P. 15, V. 1, A. 54-58, C. 22, L. l. 112, Cœc. pyl. 26.

Length of head 4 to $4\frac{2}{3}$, of caudal fin 8 to $9\frac{1}{2}$, height of body $4\frac{1}{2}$ to $5\frac{1}{2}$ in the total length. *Eye*—diameters $3\frac{3}{4}$ to 4 in the length of the head, $1\frac{1}{2}$ to 2 diameters from the end of the snout, and one apart. Interorbital space nearly flat. Snout obtusely rounded : mouth nearly horizontal : upper jaw overlapping the lower : the maxilla reaches to beneath the middle or even hind edge of the eye. A barbel as long as the eye below the symphysis of the mandible. Nostrils patent. Gill-rakers short, about 8 in number along the outer branch of the upper lamina. *Teeth*—villiform in the jaws and in an angular band on the vomer : none on the palatines or tongue. *Fin*—the first dorsal commences above the first third of the pectoral, its third or fourth rays elongated : the second dorsal not confluent with the caudal, its rays simply branched. Pectoral somewhat pointed, and as long as the head behind the middle of the orbit. Caudal rounded or square at its posterior extremity. Ventral consisting of a single ray which branches into

two: Dr. Moreau observes that it has three, two being concealed in the skin. Cœcal appendages long, about 26 in number. *Air-bladder*—with thick walls it forms a simple sac rather constricted anteriorly, where it ends in two horn-like processes. Along either side of the organ are a row of numerous hollow lateral appendages, that communicate with the interior of the air-bladder by transverse oval orifices. There is a slight constriction, visible internally, about the middle of the length of the air-bladder. A large gland exists in its anterior half on the inner side of its anterior wall. In the posterior half of the air-bladder is a species of diaphragm formed of its lining membrane. Vent situated on a vertical line beneath the commencement of the second dorsal fin. A few fine scales over the bases of the vertical fins. *Colours*—brownish-gray, becoming paler on the sides and beneath: dorsal, pectoral, caudal and anal fins yellow edged with black, the latter having a narrow white outer edge: ventrals light gray, white externally.

The *P. Mediterranea*, Laroche, is very similar, but possesses a rounded first dorsal fin which is not elevated: and the ventral is nearly the same length as the head. Cuvier considered this last to be *Blennius phycis*, Linnæus, and not the form figured by Pennant.

Varieties.—Cornish considers Couch's "Blennoid fork-beard" as one of these fish out of condition.

Names.—*Common fork-beard* or *forked hake. Hakes-dame*, Cornwall. *Le phycis blennoïde*, French.

Habits.—Mostly seen off our coasts during the winter, and but little is known respecting its habits: it appears to prefer a sandy and muddy bottom. Thompson's first example was taken "February 24th, 1836 (a calm day), with a gaff or hook as it lay floundering on the surface of the water: was very violent when brought on board, and before dying had struggled so hard as to divest itself of nearly all its scales." It was 25 inches long. The stomach of one contained two small whitings and several crustaceans.

Means of capture.—Usually with a hook and line.

As food.—Mr. Cornish observes that its flesh is extremely delicate and much superior to the whiting.

Habitat.—Along the coast of Scandinavia, the German Ocean, and the Atlantic coasts of Europe extending into the Mediterranean, where it is common.

It has been recorded as rare in Banff (Edward): St. Andrew's (Wern. Mem. vi, p. 569): several on the coasts of the Solway Firth, and one in December, 1833, at Bowness (Yarrell): Mr. Jackson obtained one, 21 inches long, March 1st, 1880, from off Southport: it is rare in Devonshire, but, according to Couch, common in Cornwall during the autumn and winter months, but rare in the opinion of Mr. Cornish, who obtained one at Penzance in 1864, and another at Land's End April 8th, 1870: on December 8th, 1873, one was taken in a herring net at Looe (Clogg), and on August 13th, 1866, an example, 19 inches long, was captured off the north-east of Guernsey. Pennant has recorded it from Flintshire: and on January 24th, 1812, Templeton took one, 20 inches in length, from among some haddock.

In Ireland it has been taken on the north-east coast in a very few instances (Thompson). Two from Carrickfergus, March, 1839, 15 inches long: December, 1840, one 26 inches. January 28th, 1849, a male 22 inches, Portaferry, county Down. In the winter of 1865, two examples were obtained by J. Blake-Knox, one a foot long from the stomach of a conger, one trawled, 1 foot 5 inches long (Zool. 1866, p. 508).

The example is figured life size. The species has not been recorded above 2 feet long from the British Isles.

Genus IV—Molva, *Nilsson.*

Lota, sp. Cuvier.

Branchiostegals seven: pseudobranchiæ absent. Body elongate and nearly cylindrical. A barbel below the chin. A band of cardiform teeth in the jaws and on the vomer, among which are some large ones in the lower jaw and on the vomer: none on the palatines or tongue. Two dorsal fins and one anal: caudal distinct. Ventral with six rays. Minute scales over the body.

Geographical distribution.—Marine fishes inhabiting the temperate waters of the northern hemisphere.

1. Molva vulgaris, Plate LXXXVI.

Clarias marina, Belon. De Aquat. p. 131. *Asellus longus*, Schonev. p. 18; Willugh. p. 175, t. L 2, no. 2; Ray, p. 56; Rutty, Dublin, i, p. 356. *Gadus*, sp. Artedi, Synon. p. 36, no. 9, Genera, p. 22, no. 9. *Lange*, Ström, Söndm. i, p. 292. *Ling*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 197 (Ed. 1812) iii, p. 262; Low, Fauna Orcad. p. 198. *Lingue*, Duhamel, Pêches, ii, sect. 1, cap. 8, p. 145, pl. xxv, f. 1.

Gadus molva, Linn. Syst. Nat. i, p. 439; Gmel. Linn. p. 1170; Shaw, Zool. iv, p. 151, pl. xxiii; Bonn. Atl. Ich. p. 49, pl. xxx, f. 108; Fabr. Faun. Greenland, p. 148; Bloch, Fische Deuts. ii, p. 174, t. lxix; Lacép. ii, p. 432; Donovan, Brit. Fish. iv, pl. cii; Turton, Brit. Fauna, p. 91; Nilss. Prod. p. 45; ? Faber, Fische Isl. p. 86.

Enchelyopus molva, Bl. Schn. p. 51.

Gadus raptor, Nilss. Prod. p. 46.

Lota molva, Jenyns, Man. p. 448; Yarrell, Brit. Fish. (Ed. i) ii, p. 180, c. fig. (Ed. 2) ii, p. 264 (Ed. 3) i, p. 569; Parnell, Wern. Mem. vii, p. 352, and Fish. Firth of Forth, p. 192; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; Swainson, Fishes, ii, p. 300; Johnston, Berwick. Nat. Hist. Club, 1838, p. 173; White, Catal. p. 92; Schlegel, Dieren Neder. p. 84; McIntosh, Fish. N. Uist, P. R. Soc. Edin. v, 1862-66, p. 614; Thompson, Nat. Hist. Ireland, iv, p. 185; Moreau, Poiss. France, iii, p. 258.

Molva vulgaris, Flem. Brit. Anim. p. 192; Nilss. Skand. Fauna, iv, p. 573; Günther, Catal. iv, p. 361; Malm, Wiegm. Arch. 1864, p. 297; McIntosh, Fish. St. Andrew's, p. 178; Collett, Norges Fiske, p. 115; Winther, Ich. Dan. Mar. p. 32.

Ling, Couch, Fish. Brit. Isles, iii, p. 89, pl. cxlv.

B. vii, D. 13-16/63-70, P. 19, V. 6, A. 57-66, C. 35-38, Cœc. pyl. 32, Vert. 27/37.

Length of head 5, of caudal fin about 11, height of body 7 to 8 in the total length. *Eyes*—diameter 5 to 7 times in the length of the head, $1\frac{1}{2}$ to 2 diameters from the end of the snout, and 1 to $1\frac{1}{4}$ apart. The width of the head equals 2/5 of its length. The maxilla reaches to beneath the middle of the eye: upper jaw the longer. The mandibular barbel extends to beneath the centre of the orbit. Anterior nasal valve prolonged into a short barbel. *Teeth*—cardiform in the jaws, with an inner row of rather widely separated and larger ones in the mandibles: in a semicircular band on the vomer, among which a few larger ones are interspersed; none on the palatines or tongue. *Fins*—the first dorsal commences above the last half of the pectoral, its highest rays equalling about 2/5 of the depth of the body below it, while scarcely any interspace exists between its base and that of the second dorsal, which terminates close to the root of the caudal fin. Pectoral about half as long as the head. Ventral jugular. Anal commences beneath the seventh or eighth ray of the second dorsal and ends close to the base of the caudal fin, which last is rounded and distinct. *Scales*—very small, covering the head, body, and fins. *Lateral-line*—at first slightly descends, becoming straight beneath the commence-

ment of the second dorsal. *Colours*—Back gray, becoming lighter on the sides and beneath: dorsal, anal, and caudal fins edged with white: a darkish blotch at the posterior end of the first dorsal fin and a more distinct one on the end of the second dorsal. In the *young* the back and sides are yellowish-olive, broken up and divided into patterns by pale lilac lines.

Varieties.—Ogilby (Zool. 1876, p. 4904) observes that a variety is common at Portrush, co. Antrim, "it is of a pale violet colour, irregularly mottled with dark purple, almost black spots, and grows to the same size as the usual kind: it is caught only on a particular part of the bank, and is called by the fishermen 'spotted ling.'" Similarly spotted ones are taken off Mevagissey and termed *shipwrights*, having a resemblance to the spilt pitch on the clothes of these mechanics.

Names.—*Ling* is stated by most authors to be a corruption from "long," because this fish is similar in appearance to the cod but more elongated! *Kellin*, Aberdeen: *lahan*, Moray Firth: *drizzle* if small: it has also been known, according to T. Satchell, as *ling-drizzle*, *olic*, *spotted-ling*, *white-ling*, and *stake*. *De leng*, Dutch. *La lingue*, French.

Habits.—A ground fish, preferring deep water and rocky places and caverns. It is very tenacious of life and survives severe injuries. Mr. Reed took a salmon 27 inches long out of a ling 6 feet in length, captured off Wick. Couch found skulpins, *Callionymus lyra*, and even a "rough-hound" of considerable size inside a ling. Like the pike of our fresh waters, this fish has the credit which it apparently well deserves of greedily bolting any sort of foreign substance it comes across. One was captured some years since off Brandon Head, county Kerry, inside which was a pewter flask containing two glasses of ardent spirit. Another was taken November 17th, 1881, which weighed 25 lb.; in the stomach of this fish Mr. Boal, of Consett, found a three-gill bottle, some herrings, and a codling. There were also several pieces of parchment and bits of sealing-wax, which induce the supposition that the fish had swallowed one of those mournful messages of shipwreck which have recently been so numerous.

Means of capture.—Hand-lines, also long-lines. The ling fishermen in Galway generally remain out a week, but every night seek shelter in a harbour in Boffin Island. In the north of Ireland ling and conger are generally fished for at the same time. In the Orkneys the long lines contain several hundred hooks placed at a certain distance apart, baited at night, examined and rebaited the next morning: it is by no means uncommon to find that dog-fish and sharks have cleared the lines prior to the fishermen's visit.

Baits.—A slice of plaice, flounder, herring, conger or cuttle. Usually it refuses bait unless living or very fresh: while it does not appear to be partial to crustacea.

Breeding.—Spawns in spring up to June, Pennant observing that they "deposit their eggs in the soft oozy ground at the mouth of the Tees: and at that time the males separate from the females, and resort to some rocky ground near Flamborough Head, where the fishermen take great numbers without ever finding any of the females or roed fish among them." After spawning they remain out of condition till about August.

Uses.—When salted, ling is a considerable article of commerce, especially with Spain and Italy. When in season the liver is of a white colour, and affords a large amount of oil, which is used for lamps, medicinal or other purposes. Their roe is consumed as food or preserved in brine, and is often employed for attracting other marine fishes to localities where their capture would be facilitated. From the sounds or air-bladders of this fish a considerable amount of coarse isinglass is manufactured, similar to that obtained from the cod. Ling split for curing should not be less than 26 inches from the shoulder to the tail: smaller ones being termed *drizzles*.

As food.—Is mostly preferred salted, and the periods for its capture are in Zetland from May 20th to August 12th (Edmonston): Yorkshire from February to May, or even to the end of that month: January and February in the south-west of England: and March until May in the north of Ireland (Brabazon). Scilly has long been celebrated for its dry ling, and it may perhaps derive its

name from *zilli*, being the Cornish term for this fish, though it is sometimes made to include the cod also (R. Couch). Rowell observes that when boiled it is much like cod, but firmer and whiter, and has a finer flavour, but to make a dinner of it, it should be baked, well seasoned with nutmeg, salt and pepper, and a lump of the liver cooked with it. When thus prepared it makes a dinner one can eat with great relish, and feel very satisfied after it.

Whether this fish is as common on our shores as it was formerly may be questioned. In L'Estrange's Household Book, A.D. 1519, exists the following entry. "Item.—Pd. for half a hundred lynge, x*d*. Item.—For carrying of ye same lynge fr. ye Bulle to ye comon Stath, iiij*d*."

Habitat.—This species has been recorded from Spitzbergen to the extreme western portion of the Mediterranean, but is most abundant along the coasts of northern Europe to Iceland, more especially in the German Ocean and off Norway. To the north of Iceland it becomes rare, neither is it abundant off Greenland and the Faroe Islands, while it is absent from the Baltic. It is found off Newfoundland.

This species of the Gadidæ, next to the cod and coal-fish, is the most common fish of the Orkneys (Low). Large quantities are likewise taken off the western isles. It has been mentioned as being present at Wick (Reed): Banff (Edward): Aberdeen (Sim): common at St. Andrew's (McIntosh): in the Firth of Forth it is taken with lines principally about the Isle of May, where it is found more plentiful than further up the estuary: occasionally small ones are met with near Inchkeith, but scarcely ever above Queensferry (Parnell). Off Yorkshire it is resident and abundant (Yorkshire Vertebrata): common in the Norfolk estuary but not of large size (Lowe): while along the south coast it is much more common in Cornwall than off Devon (Parfitt), becoming abundant off Scilly. It is found nearly all round the Irish coast.

The example figured is 17 inches long, from Devonshire. Thompson records one of 59 lb. weight from Ireland: Reed of an example 6 ft. long and weighing about 60 lb., taken at Wick in March, 1872: Parnell heard of one which measured 7 ft. in length, and Couch also was told of a Scilly example of 124 lb. weight.

Genus V—Lota, *Cuvier.*

Branchiostegals seven or eight: pseudobranchiæ absent. Body elongated. A barbel below the chin. Cardiform teeth on jaws and vomer, none on the palatines or tongue. Two dorsal fins and a single anal: caudal distinct: ventral with six or seven rays. Small scales over the body.

Geographical distribution.—Fresh-water fishes inhabiting the temperate portions of northern Europe and America.

1. Lota vulgaris, Plate LXXXVII.

Mustela, Pliny, Hist. Nat. ix, c. 16. *Strinsias s. Botarissas*, Belonius, De. Aquat. p. 302, etc. and *Clarias fluviatilis*, l. c. p. 304. *Lota*, Rondeletius, ii, p. 164, and *Barbota*, p. 165. *Botlatriæ, triseus*, Salviani, p. 213. *Mustela fluviatilis*, Gesner, p. 599, and ed. 1598, fol. 172*b*, c. fig. *Quappen*, Schonevelde, p. 49. *Lota Gallorum*, Aldrovandus, v. c. 46, p. 648; Jonston, iii, tit. 3, c. 11, p. 168, t. xxix, f. 10. *Mustela fluviatilis*, Willughby, p. 125, t. H 3, f. 4; Ray, Syn. Pisc. pp. 67, 68. *Gadus barbatus*, Müller, Prod. Zool. Dan. p. 41; Koelreuter, Nov. Com. Petroph. 19, p. 424. *Gadus*, sp. Artedi, Synon. p. 38, no. 13, and Genera, p. 22, no. 10, and *Silurus cirro in mento unico*, Species, p. 107. *Rutten*, Marsigli, Danub. iv, p. 71, t. xxiv. *Burbot*, Pennant, Brit. Zool. (ed. 1776) iii, p. 199 (ed. 1812) iii, p. 265. *Barbolt*, Bowdich, British Fresh-water Fishes, 1828, no. xxx.

Gadus lota, Linn. Faun. Suec. 315 and Syst. Nat. p. 440; Bonn. Atl. Ich. p. 49, pl. xxx, f. 110; Bloch, p. 177, t. lxx; Gmel. Linn. p. 1172; Lacépède, ii, p. 435; Donovan, British Fishes, iv, pl. xcii; Shaw, Gen. Zool. iv, p. 154, pl. xxiii, f 2; Turton, Brit. Fauna, p. 91; Pallas, Zoogr. iii, p. 201; Hartmann, Helvet. Ich. p. 50; Ekström, Vet. Akad. Handl. p. 43, and Fische Mörkö, p. 235; Brandt and Rat. i, p. 52, t. vii, f. 2.

Enchelyopus lota, Bloch, Schn. p. 52; Gronov. ed. Gray, 1854, p. 101.

Lota vulgaris, Cuv. Règne Anim.; Jurine, Poiss. Lac. Leman, 1825, pl. ii; Nilsson, Skand. Fauna, iv, p. 580; Jenyns, Manual Brit. Vert. p. 448; Yarrell, Brit. Fishes (Ed. 1) 1836, ii, p. 183, c. fig. (Ed. 2) ii, p. 267 (Ed. 3) i, p. 572; Fries och Ekström, Skand. Fisk. p. 170, t. xli; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 350; Kröyer, Dan. Fiske, ii, p. 169, c. fig.; White, Catal. p. 93; Günther, Fische Neckar, p. 124, and Catal. iv, p. 359; Heckel and Kner, Suss. w. fis. ost. Mon. p. 313; Blanchard, Poiss. Eau. dou. France, p. 272, c. fig.; Schlegel, Dieren Neder. p. 82, pl. viii, f. 1; Malm, Wiegm. Arch. 1864, p. 297; Steindachner, Verh. z. b. Ges. Wien. 1866, p. 387; Collett, Norges Fiske, p. 115, and Christ. Vid. Sels. Forh. 1879, i, p. 67; Houghton, British Fresh-water Fishes, p. 165, c. fig.; Day, Cotteswold Nat. Field Club, 1880, p. 221, c. fig.; Moreau, Poiss. France, iii, p. 256; Giglioli, Pesc. Ital. p. 37.

Molva lota, Fleming, Brit. Anim. p. 192.

Lota communis, Rapp, Fische Bodensees, p. 36.

Burbolt, Couch, Fish. Brit. Isles, iii, p. 93, pl. cxlvi.

Synonymy of American examples.

Gadus lota, Schöpf, Schrift. Gesell. Nat. Freund. Berlin, viii, p. 141; Pennant, Arctic Zool. Introd. p. cxci.

Gadus lacustris, Mitchell, Amer. Month. Mag. ii, p. 244.

Lota maculosa, Leseur, Journ. Acad. Nat. Sc. i, p. 83; Richardson, Fauna Bor.-Amer. Fish, p. 248; Kirtland, Boston, Journ. Nat. Hist. 1842, iv, p. 24, pl. iii, f. 1; De Kay, New York Fauna, Fish, p. 284, pl. lii, f. 168; Agassiz, Lake Superior, p. 325.

Molva maculosa, and *M. huntia*, Leseur, Mém. Mus. v. 1819, pp. 151, 161, pl. xvi.

Lota compressa, Leseur, Journ. Ac. Nat. Sc. i, p. 84; Storer, Fish. Mass. p. 134; De Kay, l. c. p. 285, pl. lxxviii, f. 244, 245.

Lota inornata, De Kay, l. c. p. 283, pl. xlv, f. 145.
Lota brosmiana, Storer, Boston Journal, iv, pl. v, t. 1.

B. vii-viii, D. 12-14/67-76, P. 19-21, V. 7, A. 65-71, C. 30, Cœc. pyl. 25-30, Vert. 21/38.

Length of head $5\frac{1}{4}$ to $5\frac{1}{2}$, of caudal fin $12\frac{1}{2}$, height of body $5\frac{1}{2}$ to $7\frac{1}{2}$ in the total length. *Eye*—diameters 8 to 9 in the length of the head, $2\frac{1}{2}$ diameters from the end of the snout, and $2\frac{3}{4}$ apart. Body subcylindrical anteriorly, becoming compressed in its posterior half. Head broad, its greatest width equalling its length excluding the snout. Gape of mouth wide: jaws of equal length anteriorly: the posterior extremity of the maxilla reaches to beneath the middle of the eyes. A single barbel beneath the symphysis of the lower jaw. *Teeth*—cardiform, and of equal size in the jaws and on the vomer, none on the tongue. *Fins*—first dorsal somewhat lower than the second: caudal rather wedge-shaped, its lower portion commencing somewhat anterior to its upper: second ventral ray the longest in the fin. *Air-bladder*—destitute of a pervious pneumatic duct, equalling one-third of the entire length of the fish, narrow, and terminating anteriorly in two rounded, horn-like processes: superiorly it is closely attached to the vertebral column in its entire length. *Cœcal appendages*—from 25 to 30, and of moderate length. *Scales*—small, mostly concealed in a thick mucus which covers the body. *Lateral-line*—at first slightly descends, and then continues direct to the centre of the base of the caudal fin. *Colours*—body of a dull yellow or brown, variegated or banded with darker bands or blotches, sometimes studded with pale or else black spots: fins marked similarly to the body. Iris golden, pupils bluish. The colours vary with the waters these fish inhabit: a white variety has been recorded by Baldner.

Names.—Pliny alludes to the *Mustela*, or "Weasel Fish," of Lake Constance, which he considered as food rivalled marine forms. In England its local names are various: *Burbot*, or *Burbotte*, which has been considered to be a corruption of its French designation *Barbotte*, "a bearded fish," but it is likewise termed *bird-bolt*, which, according to Nares, designates a thick arrow having a broad flat head, employed to kill birds without piercing the skin. Also *blob-kite* (Buckland). *Eel-pout*, according to Gesner, is derived from its Dutch name *ael-putt*, or *putael*, a compound word, signifying *ael*, "an eel," and *purt* or *pud*, "a frog,"* but Schlegel observes that the name he alludes to belongs to *Zoarces viviparus*. *Coney-fish* appears to be derived from its habit of lurking in holes of river banks, as a *coney* or "rabbit" does on land. Its Anglo-Saxon name was *Aelepúta*. *Kwabaal*, Dutch. *Le lote commune* ou *barbotte*, French.

Habits.—The Burbot prefers clear and still rivers and lakes, at the bottom or sides of which it lurks in holes or crevices among the stones, or even skulks in rat-holes and cavities under banks. One was kept alive some months last year in one of the tanks in the Royal Westminster Aquarium; it selected the darkest corners, and appeared very unwilling to be seen; when compelled to change its situation, it did so with great deliberation, and never hurried itself. While moving, its ventral fins appeared to be used to a considerable extent as feelers; in fact outwardly it much resembled some American fresh-water Siluroids, which had previously resided in the same tank. This fish lives for a considerable period after its removal from the water, and, being very tenacious of life, can be kept alive for some time in cold and damp situations by feeding it on small fishes and pieces of raw meat. In some places it is kept in stews, where it fattens well and will eat almost any animal substance. It is reputed to grow rapidly when well fed, is very voracious, feeding at night, when it consumes a great quantity of small fish, worms, and aquatic insects. Although it has been stated to agitate its barbel in order to decoy little fish to its vicinity, this would appear to be improbable, as that appendage is situated beneath its chin. In suitable localities the burbot is said to attain to a good old age. Its greatest enemy is perhaps the perch, which seems invariably to attack it: the pike likewise esteems it as food.

* Mr. Houghton would derive the term *Eel-pout* from the fact of the fish resembling an eel, but being more full-bellied or pouting.

Means of capture.—It is taken by nets, baited hooks, trimmers, or night lines, while owing to its destructive habits it is not protected during the breeding season at Neuchâtel.

Baits.—A gudgeon or red worm.

Breeding.—The example figured was a female, captured in March, 1879, in the River Thet, in Norfolk; its ova at that period were not fully matured, but it must be remembered that the season was unusually cold. Some authors observe that it deposits its ova in December and January; Yarrell states February or March: while it may breed rather later in England than on the Continent. Leon Baltner found 128,000 eggs in one example. At spawning time it leaves the deeper waters, and seeks smooth localities in streams, where it deposits its eggs.

Uses.—In the Oder these fishes were formerly much sought after, the fattest of those not disposed of being cut into slips, dried, and employed as candles. Oil from their livers was likewise used as an external remedy for swellings; while the gall, in common with that of some other fishes, was recommended for its supposed efficacy in affections of the eyes. Glue (isinglass) was manufactured from its air-bladder. It is stated in the Encyclopædia Londinensis that "in Siberia and many parts of Russia, especially among the country people, they employ the skin of this fish instead of glass, and it is as clear as oiled paper: the Ostides and Tschulymch Tartars use the skins for their summer dress, and make bags of it to preserve their pelfry." This may be erroneous, and the fish alluded to be eels, or perhaps both, for Mr. Eden* observes "some members of this race (the Ostiaks) use fish-skin clothing in place of furs, the eels, which abound throughout the country, furnishing the material. These skins are very strong, and quite air-tight, excluding an immense deal of cold when well rubbed with fat. They are also used as windows to their yurts."

As food.—The burbot has long been esteemed as a great luxury, but more so on the Continent than in this country; its flesh is white and delicate, while its liver is its most delicious morsel. Aldrovandus has recorded how a German Countess carried her epicurism so far as to expend the greatest portion of her income in the purchase of this dish. Its eggs, however, are unwholesome, and occasionally even poisonous. But De Kay says it is a poor article of food, even the dogs in the Arctic regions refusing to touch it.

Habitat.—This fish, although distributed throughout northern and central Europe, also Canada and the adjacent portions of the United States, is still rather local in its habits. Prior to the time when the geographical distribution of animals began to be attended to, it was asserted that the Burbot was found in India, a locality which was very properly discarded until the error was reintroduced by Lacépède at the end of the last century, and which has been copied by Donovan, Yarrell, and Couch. No fresh-water species of the cod family, *Gadidæ*, exist in India, while in the sea or backwaters is only the single and aberrant genus of *Bregmaceros*.

In Continental Europe the burbot is found throughout most of its northern, central, and eastern portions: in Norway, Sweden, and rivers flowing into the Baltic and Black seas; in Siberia, through central Europe from Hungary to Switzerland, Germany, and as far south as France. An interesting fable exists respecting the introduction of this fish into the Lake of Geneva. Jurine asserted that, according to popular tradition, the burbot was brought there from Neuchâtel, while Blanchat, in his Natural History of the environs of this latter place, attributes its introduction to the monks of St. Prex, in the fourteenth century. In support of this opinion, Lunel, author of the Fishes of Lake Leman or Geneva, refers to a map of the Lake engraved at Geneva, in 1588, by Jean du Villard, who has given in the margin figures of the fish, with their local names. All are recognizable, but the burbot and eel are not represented, and due to the impassable barrier of the Perte du Rhône, at Bellegarde, migrations of the latter to or from the sea are impossible. This absence of the burbot was held to coincide with the local tradition, but, as observed by Professor Forel at the

* Eden, Frozen Asia, 1879, p. 142.

Vaudois Natural History Society, the following facts refute such a belief. Rondelet, in 1555, published at Lyons descriptions of the Fresh-water Fishes of Europe, and observed of the burbot, "the fish which the Lyonese call the Lotte, is named by the Genevese Motelle or Mustele." Motaile is still the popular name of this fish, and, having even then a local name, it must have been well known. Rondelet's work was published thirty-three years prior to Du Villard's map, and he gives a figure by which this fish can be recognized. Irrespective of this, the monks of St. Prex in the fourteenth century had neither a convent nor were any of their order attached to the Chapter at Lusanne.

In Scotland the burbot is generally considered absent. Mr. Sim, who has given an interesting account of the fishes of Aberdeen, included it as among the local Fauna, on the authority of a statement by the late Dr. Dyce. This last gentleman made the following note at the end of the article on the *burbot* in Yarrell's British Fishes: "June, 1861, two specimens found in market to-day, never met with the fish before. One 13½ the other 12½ inches long. Upper jaw the longest, teeth very sharp, black line all round tail." Where the fish came from, if ascertained, was not recorded. In the Catalogue of the Fishes in the British Museum we find seven skins of *Lota vulgaris* thus recorded—"adult: skins, Firth of Forth. From Dr. Parnell's collection." Were this unimpeachable it would conclusively prove its existence north of the Border; but even at first sight it would seem strange that this fresh-water fish should be captured in the locality referred to, more especially as Dr. Parnell himself does not allude to its existence there in his prize essay on the Fishes of the Firth of Forth. I find in the British Museum Registry that when Dr. Parnell's collection of 1636 specimens of fish obtained from all parts of the world, was recorded, no locality was given as to from whence these seven skins came. I conclude they were obtained from elsewhere, and are certainly unreliable as Scotch examples. Here, however, I would remark that the burbot is placed among the *Siluridæ* by Artedi, showing how minute or concealed the scaling is to have been overlooked by such an excellent ichthyologist. This would lead us to consider whether others may not have been equally mistaken when examining specimens, supposing such to be scaleless Siluroids. Fleming found at the end of Sibbald's list* of Scottish Fishes *Siluris sive glanis*, and on this authority introduced the *Siluris glanis* of Continental Europe into his catalogue of British animals, although Willughby, who mentions *Siluris glanis*, does not refer to Great Britain as one of the localities which it inhabits. It may be that the burbot was alluded to by Sibbald, or it may be that his authority was no better than the one I have alluded to respecting Parnell's examples.

In England it is found in the rivers and some of the lakes in the county of Durham: also in sluggish Yorkshire rivers where, however, it is not numerous. It is reported as comparatively common in the River Holl, the Lower Derwent, the Wiske, the Foss, the Ouse below Naburn, and in dykes about Selby: and as scarce in the Seven, Pickering-beck, and other tributaries of the Upper Derwent, the Codbeck, the Nidd, and the Wharf (Yorkshire Vertebrata). In Norfolk it is taken in small numbers in the Yare, the Bare and the Waveney, penetrating up to their sources: is not common in the district of the broads but is more abundant in the Thet (Lubbock). Also in the Trent and its affluents in Nottinghamshire and Staffordshire,† where the largest examples have also been obtained: in the great east fen in Lincolnshire, although it is not generally distributed over that county; it is also found in Cambridgeshire. The belief, however, is prevalent that the species is decreasing in numbers, and perhaps doomed to extinction. As a proof of this it may be mentioned that in September, 1879, when clearing out a small stream, an affluent of the Tame which joins the Trent, one of these fish was captured, but was only recognized by a single individual who remarked that thirty years since he had seen examples. Mr. Frank Buckland

* Sibbald gives in his Scot. Illus. *Ealpout* as one of the fishes of that country, but he employs the name for the viviparous Blenny, see pl. xix, fig. 3.

† Plot in his Natural History of Staffordshire, 1686, alluded to its existence, but even then it was rare. Mr. Heath observes that it is still found in the River Penk in that county.

states that S. Gurney, Esq., M.P., turned some of these fishes into the Wandle, near Carshalton.

As regards Ireland, an unique example of a fish which some have considered may be the *Silurus glanis* is stated to have been captured about 1827 or 1828 from a tributary of the Shannon, near its source, about three miles above Lough Allen. A fisherman asserted that a fish at least $2\frac{1}{2}$ feet long, and 8 lb. or 9 lb. weight, was seen struggling in a pool in the river as a flood subsided; that it had worm-like feelers to its mouth, while its appearance was so hideous that those who first saw it were afraid of touching it. The mouth in the figure of *Silurus glanis* in Yarrell's British Fishes was not considered large enough for that of the Irish specimen, but it must be observed that inquiries were only instituted in 1840. The captured fish was not eaten, but adorned a bush for two or three years, until the skeleton fell to pieces, and with it all evidence to connect *Silurus glanis* with Ireland.* Some have surmised that the fish may have been a burbot, but it is manifestly impossible to identify any species by the evidence adduced.

The burbot usually attains to about 2 or 3 lb. weight in this country, but Pennant records an example of 8 lb. captured in the Trent by Sir Jervase Clifton. On the Continent they are taken up to 10 or 12 lb.

The example figured was over 11 inches in length, and was procured from the Thet for me by the Rev. W. Symonds, of Pendock, who subsequently kindly sent me a black spotted male. Inside the stomach of the figured fish was an almost entire loach, *Nemacheilus barbatulus*, $2\frac{1}{2}$ inches in length.

* One or more, *fortunately unsuccessful*, attempts have been made during the last few years to introduce this hideous monster into British rivers. *Silurus glanis* has a voracious appetite, is a foul feeder, inferior as food, and almost rank when of a large size, its presence would be of exceedingly questionable advantage.

Genus VI—Motella, *Cuvier.*

Onos, Risso: *Mustelus*, Stark: *Gadus*, Fleming. *Ciliata (young)* Couch: *Couchia (young)* Thompson. *Movella*, Kaup. *Hypsiptera*, sp. Günther.

Branchiostegals seven: pseudobranchiæ absent. Body elongated, rounded in front, compressed behind, upper surface of head flattened. Three or more barbels on the snout, lips, and below the mandibular symphysis. Teeth present in a band on the jaws and vomer. Two dorsal fins, the first consisting (excepting the first ray) of very slender rays lodged in a depression, the second fin elongated and continued almost to the base of the caudal fin. A single anal. Ventral having from three to eight rays. Caudal distinct from dorsal and anal. Scales minute. Cœcal appendages few or in moderate numbers.

The adult fishes of this genus are commonly known as *rock-lings*, from which the young have been separated as *mackerel-midges*, and termed *Ciliata* by Couch, and subsequently *Couchia* by Thompson. Likewise Dr. Günther has referred some of his types of *Hypsiptera* Günther (see page 303) to *Couchia argentata*, which is the young of *Motella tricirrata*. When Couch first proposed this new genus of *Ciliata* at the Linnean Society, "they hesitated to publish it, believing that the fish was a young condition of some other known species" (Couch). The young are uncertain in their appearance, for in some seasons only a few can be detected; while in others they are seen in countless multitudes. During March, April, and even as late as June, they are found near the surface of the sea in scattered communities, from one to twenty miles from land, and frequently several schools join together. In stormy weather they are thrown on board vessels with the spray, or drawn into fishing boats with the nets: they seek shelter during heavy seas under the protection of any floating object, and are frequently seen among the sea-weed, or under the protection of a medusa. These little fishes are so sought after for food by predaceous forms as mackerel and bass, that they have been termed "mackerel-midges," and when they grow larger assuming the *Motella* or "rock-ling" size, they are likewise much relished, especially by conger-eels. In an aquarium these fishes keep the first dorsal fin in almost continuous motion, similar to the fin movements in pipe-fishes, *Syngnathus*. The young, or mackerel-midges, die almost immediately on being removed from the sea.

Mr. Sim has recorded having captured on July 15th, 1868, at Aberdeen, a small mackerel-midge which possessed seven barbels: it was transmitted to Mr. Couch, but appears to have been lost; consequently it remains doubtful whether it was a distinct species or variety of a known form; the additional barbels appear from the drawing to have had their origin at the posterior nostrils. Some authors have believed that the number of barbels are insufficient characters on which to found species, and that the *five-* and the *three-bearded rock-lings* are identical. Along the S.W. coast I have obtained three species of *Motella*, and also three species of mackerel-midges which I believe to be their young stages. The young *M. mustela* is brown with blue eyes: the two others are silvery white but darkest along the back: the one I believe to be *M. tricirrata* has also a black axillary spot, and a black mark on the ventral fin: the upper surface of its head flat: the young *M. cimbria* is of a similar colour without the spots, its interorbital space convex, and its head short. Dr. Günther has separated from *M. tricirrata* some British specimens which he believes appertain to *M. maculata*, Risso, giving as a reason the character of their teeth, those in the upper jaw in the former being in a band, whereas in the latter there exists an outer enlarged row, and this last species is said to possess one less abdominal vertebra. These two very similar forms inhabit the same localities, and the question naturally arises, can they be varieties of one species or sexual variations? All I have taken furnished with an enlarged outer row of teeth in the upper jaw, or *M. maculata* in the British Museum Catalogue, are males. But although the number examined is insufficient on which to base

absolute conclusions, it seems very possible that *M. tricirrata* is the male of *M. maculata* (part) Günther, and further evidence is desirable before admitting the latter to rank as a species.

Geographical distribution.—Seas of northern and temperate Europe, also Greenland, extending along the Atlantic to Madeira and the Cape of Good Hope. It has also been obtained from New Zealand, Japan, and likewise from the Island of St. Paul.

There would appear to be four species of *Motella* found along the British coasts: 1. *Motella mustela*, with five barbels, D. 47-55, A. 40-46. 2. *Motella cimbria*, with four barbels, D. 50, A. 44. 3. *Motella tricirrata*, with three barbels, D. 55-57, A. 48-50. 4. *Motella macrophthalma*, with three barbels, D. 55, A. 55.

1. **Motella mustela,** Plate LXXXVIII, fig. 2.

Mustela vulgaris, Willughby, p. 121; Ray, p. 67. *Gadus*, sp. Artedi, Synon. p. 37, no. 11, Genera, p. 22, no. 2; Gronov. Zooph. no. 314. *Five-bearded cod*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 202, pl. xxxiii (Ed. 1812) iii, p. 268, pl. xxxvi. *The whistle-fish*, Low, Fauna Orcad. p. 199.

Gadus mustela, Linn. Syst. Nat. i, p. 440; Gmel. Linn. p. 1173; Donovan, Brit. Fish. i, pl. xiv; Shaw, Zool. iv, p. 156; Turton, Brit. Fauna, p. 92; Flem. Brit. Anim. p. 193; Holb. Bohusl. Fisk. ii, p. 52, c. fig.; Faber, Fische Isl. p. 81; Schlegel, Dieren Neder. p. 85, pl. viii, f. 5.

Gadus fuscus, Bonn. Atl. Ich. p. 50.

Enchelyopus mustela, Bl. Schn. p. 52; Gronov. ed. Gray, p. 101.

Motella quinque-cirrata, Cuv. Règne Anim.; Yarrell, Brit. Fish. (Ed. 1) ii, p. 190, c. fig. (Ed. 2) ii, p. 278 (Ed. 3) i, p. 583; Parnell, Wern. Mem. vii, p. 355, and Fish Firth of Forth, p. 195; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; McIntosh, Fish. N. Uist, Pro. Roy. Soc. Edin. v. 1862-66, p. 614.

Motella mustela, Nilss. Prod. p. 49, and Skand. Fauna, iv, p. 589; Jenyns, Manual, p. 450; Johnston, Berwick. Nat. Club, 1838, i, p. 173; White, Catal. p. 94; Kröyer, Dan. Fiske, ii, p. 185, c. fig.; Thompson, Nat. Hist. Ireland, iv, p. 186; Günther, Catal. iv, p. 364; Winther, Ich. Dan. Mar. p. 33; Steind. Ich. Span. u. Port. 1868, p. 44; Collett, Norges Fiske, p. 117; Moreau, Poiss. France, iii, p. 273.

Molvella borealis, Kaup. Wiegm. Arch. 1858, p. 90.

Five-bearded rock-ling, Couch, Fish. Brit. Isles, iii, p. 108, pl. cl, f. 1.

(*Young.*)

Ciliata glauca, Couch, Mag. Nat. Hist. v, pp. 15, 741, f. 2, and Zool. Journ. i, p. 132; Thompson, Nat. Hist. Ireland, iv, p. 192.

Motella glauca, Jenyns, Man. p. 451; Yarrell, Brit. Fish. (Ed. 1) ii, p. 193 (Ed. 2) ii, p. 281 (Ed. 3) i, p. 586; Thompson, An. Nat. Hist. 1846, xviii, p. 315; Collett, l. c. p. 121.

Motella argenteola, Düben, Vet. Akad. Handl. 1844, pp. 92, 97; Nilss. Skan. Faun. Fisk. p. 590.

Couchia minor, Thompson, Nat. Hist. Ireland, iv, p. 188.

Couchia glauca, Thompson, l. c. p. 192; Günther, Catal. iv, p. 363; McIntosh, Fish. N. Uist, Pro. R. S. Edin. v, 1862-66, p. 614.

Mackerel-midge, Couch, l. c. iii, p. 113, pl. cli, fig. 1, 2.

B. vii, D. 47-55, P. 15, V. 7-8, A. 40-46, C. 20-21, Cœc. pyl. viii-ix.

Length of head $5\frac{1}{2}$ to $6\frac{1}{2}$, of caudal fin 8, height of body 6 to 7 in the total length. *Eye*—about 1/6 of the length of the head and situated in its anterior 2.5, $1\frac{1}{2}$ diameters from the end of the snout, and 2 apart. The greatest width of the head equals its length excluding the snout: upper surface nearly flat. The

maxilla extends posteriorly to below the middle or hind edge of the eye, and is rather longer than the mandible. *Barbels*—one about as long as the eye at each anterior nostril: a short pair on the anterior edge of the snout near the median line: a single one, the longest of the five, beneath the symphysis of the lower jaw. *Teeth*—villiform in the jaws, a few widely separated rather enlarged and conical ones in the inner row on the mandible, and in a band on the vomer: none on the palatine bones or on the tongue. In the young the outer row in the upper and the inner row in the lower jaw are sharper and longer than in adults. *Fins*—the anterior dorsal commences on a line above the posterior extremity of the opercle, while the length of its base slightly exceeds that of the postorbital portion of the head; it ends above the posterior extremity of the pectoral fin. *Cœcal appendages*—nine in the example figured, eight in another from Penzance. *Colours*—of a stone, or olive, or chestnut colour, becoming lighter on the cheeks, lower surface of the head and abdomen as far as the commencement of the anal fin. Fins dark brown: pectorals and ventrals with some orange on their basal halves, the anal with a light outer edge. Outer ventral rays nearly white.

An example $1\frac{1}{2}$ inches in length was brown covered with numerous fine black spots: its eyes being bright blue: length of the head 1/5 of that of the total.

Varieties.—The barbels in this species would seem not to be invariably identical; in examining two examples, one nearly 2 (1·9) inches long the other a little more (2·2 inches), the colours were as in the adult, so were the two anterior nasal, the two rostral, and the mandibular barbels. But variations occurred in other specimens, due to the following cause. Along the edge of the snout, in an example 3 inches long, existed a row of somewhat tubular pores, the two centre of which were short barbels, in another nearly 4 inches long (3·8 inches) a similar appearance existed: but in a specimen a little over 5 (5·2) inches long the pair of rostral barbels were absent, only a line of 8 pores existed. This appears to resemble *Motella fusca* (Risso), Moreau, who obtained both forms in the same locality. Couch mentions that in some examples which he received from the north of Somersetshire, a low membrane connected each pair of the upper barbels together. In one instance, the barbs of one side were united into one, while on the other side they remained separate.

Names.—*Brown whistler* in west of Cornwall. *Pettifogger* and *baud* are said to have been two local names in Cornwall for some species of *Motella*. Pennant observes that Cornish fishermen *whistled* and made use of the words *bod*, *bod*, *reau*, when trying to capture this fish. *De meun*, Dutch.

Habits.—This species inhabits hard sandy coasts as well as rocky localities, but does not appear to live in such deep waters as *M. tricirrata*. It feeds upon small shells and crustacea.

Means of capture.—Mr. Cornish (Zool. 1879, p. 476) records one which was taken on a small hook fishing from off the rocks, but the common mode of obtaining them is from under stones as the tide ebbs.

Baits.—These are rarely used as the mouth of this fish is small.

Breeding.—Cornish obtained, August 20th, 1879, at Penzance a female full of roe partially matured. "The nest wherein the spawn is deposited is invariably formed of the common coralline, *Corallina officinalis*, thrust into some cavity or crevice of a rock close to low water-mark" (Zool. 1879, p. 476), the eggs are not contained in a chamber but scattered through the mass.

Thompson obtained young in June, from Lahinch, less than 2 inches in length.

Diseases.—McIntosh (Fish. St. Andrew's, p. 140) figures a crustacean parasite from the young of this fish (*Motella glauca*) from Lochmaddy.

As food.—It is said to be fair eating.

Habitat.—From Iceland and the northern seas through the German Ocean and Atlantic borders of Europe, and common along the coasts of France and the Iberian peninsula.

It is found off most parts of the British coasts, and has been referred to as common in the Orkneys (Low) and also in Zetland (W. Baikie): Moray Firth (Harris): Banff, frequent among pools left by a receding tide (Edward): Aberdeen (Sim): St. Andrew's (McIntosh): Firth of Forth (Parnell): and not

uncommon in Berwickshire (Johnston): also at Glasgow (Yarrell). It is resident and common off rocky shores from Redcar to Flamborough (Yorkshire Vertebrata): taken in the Norfolk estuary in August, 1870, and September, 1871 (Plowright), Yarmouth (Paget), also abundant at Cromer among stones at low water (Gurney): Lincolnshire flat, plentiful (Yarrell): mouth of the Thames: and very common off the Kentish coast, especially during autumn (Yarrell): Sussex, and generally along the south coast, examples from Plymouth and Cornwall being in the National collection: it is occasionally captured at the mouth of the Exe (Parfitt): Weymouth (Gosse): Brixham (Parnell), common along Cornwall and occasionally found in Mount's Bay about low water-mark (Cornish). I have personally taken it from rock pools at Penzance. Bristol Channel (Couch), and an example has been captured in South Wales.

In Ireland it is distributed round the coast, and is said by Thompson to be more common than *M. tricirrata*: he obtained examples from rock pools in numerous localities.

The example figured, life size, is a male from Brighton. The species has been recorded up to 18 inches in length by Fleming.

2. **Motella cimbria,** Plate LXXXIX, fig. 1.

Gadus cimbrius, Linn. Syst. Nat. i, p. 440; Bonn. Atl. Ich. p. 50; Gmel. Linn. p. 1174; Lacép. ii, p. 442; Straussenfelt, Vet. Akad. Handl. 1773, p. 22, t. ii; Goode and Bean, P. U. S. Nat. Mus. i, p. 362.

Enchelyopus cimbricus, Bl. Schn. p. 50, t. ix.

Motella cimbria, Nilss. Prod. p. 48, and Skand. Faun. iv, p. 587; Yarrell, Brit. Fish. (Ed. 2) ii, p. 274, c. fig. (Ed. 3) i, p. 579; Parn. Wern. Mem. vii, p. 449, pl. xliv, and Fish. Firth of Forth, p. 289, pl. xlvii; White, Catal. p. 94; Kröyer, Dan. Fiske, ii, p. 198, c. fig.; Günther, Catal. iv, p. 367; McIntosh, Fish. St. Andrew's, p. 178; Collett, Norges Fiske, p. 116; Winther, Ich. Dan. Mar. p. 33.

Motella caudata, Storer, Proc. Boston Am. Ac. 1848, p. 5.

Rhinonemus caudacuta, Gill, Proc. Ac. Nat. Sc. Phil. 1862, p. 241.

Four-bearded rockling, Couch, Fish. Brit. Isles, iii, p. 111, pl. cl, f. 2.

B. vii, D. /50, P. 15, V. 6, A. 44, C. 31.

Length of head $5\frac{1}{4}$ to 6, of caudal fin 7, height of body 8 in the total length. *Eye*—diameters $4\frac{3}{4}$ to $5\frac{1}{2}$ in the length of the head, 1 to $1\frac{1}{4}$ diameters from the end of the snout, and 1 apart. The greatest height of the head rather exceeds one-half of its length. Snout broad and obtuse, projecting over the upper jaw, which last overhangs the lower jaw: posteriorly the maxilla extends to beneath the hind edge of the orbit. *Barbels*—four, one slightly anterior to each front nostril; one on or close to the upper lip: and the fourth beneath the symphysis of the lower jaw. *Teeth*—cardiform in the jaws, and in a patch upon the vomer: none upon the palatines or tongue. *Fins*—the first dorsal commences above the middle of the opercle and extends to above the middle of the pectoral fin, the length of its base equals half that of the head: the rays of the posterior portion of the dorsal fin, except the last few, are higher than those in the remainder of its extent: the rays in the posterior portion of the anal similarly elongated. Pectoral rounded and as long as the postorbital portion of the head. *Colours*—of a chestnut brown along the back, becoming lighter on the sides and beneath. Dorsal fin gray edged with white and having a dark oval blotch posteriorly on its elevated portion. Anal with a dark mark in its posterior portion similar to that on the dorsal fin.

Habits.—Are probably the same as those of the other species of the genus. Parnell found the stomach of his specimen, which measured fourteen inches in length, filled with shrimps and small crabs.

Breeding.—Parnell's example, captured in June, had the ova almost ready to be deposited.

Habitat.—Coasts of Northern Europe, becoming local and somewhat rare around Great Britain, where it was first discovered by Parnell in the Firth of Forth.

It has been recorded as rare in Banff (Edward): Aberdeen (Sim): in a rock pool at the west bay of St. Andrew's (McIntosh): Firth of Forth (Parnell): Falmouth (Cocks): Cornwall small and rare (Cornish).

The example figured is 11 inches in length, and in the National collection. The longest recorded British specimen measured 14 inches.

3. **Motella tricirrata,** Plate LXXXVIII, fig. 1.

Mustela vulgaris, Rondel. ix, c. 15, p. 281; Gesner, p. 89; Aldrov. iii, c. 8, p. 290; Jonston, i, tit. 1, c. 1, art. 2, t. i, f. 4; Willughby, p. 121, t. H 4, f. 4. *Galea venetorum*, Belon. De Aquat. p. 130; Gesner, p. 90. *Mustela marina*, Ray Syn. p. 164, f. 9; Rutty, co. Dublin, i, p. 352. *Sorghe*, Willughby, t. H 2, f. 1. *Three-bearded cod*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 201, pl. xxxiii (Ed. 1812) iii, p. 267, pl. xxxvi.

Gadus mustela, Bonn. Atl. Ich. p. 50, pl. xxxi, f. 111 (not Risso).

Gadus tricirratus, Bl. t. clxv; Gmel. Linn. p. 1174; Donovan, Brit. Fish. i, pl. ii; Turton, Brit. Fauna, p. 92; Flem. Brit. Anim. p. 193.

Enchelyopus Mediterraneus, Bl. Schn. p. 52.

Gadus jubatus, Pall. Zoogr, iii, p. 202; Rathke, Faun. d. Krym, p. 333.

Motella vulgaris, Cuv. Règne Anim.; Yarrell, Brit. Fish. (Ed. 1) ii, p. 186, c. fig. (Ed. 2) ii, p. 270 (Ed. 3) i, p. 575; Templeton, Mag. Nat. Hist. 1837 (2) i, p. 411; H. Blake-Knox, Zoologist, 1866, p. 507; Parnell, Fish. Firth of Forth, p. 194, and Wern. Mem. vii, p. 354; Steind. Ich. Span. u. Port. 1868, p. 44.

Gadus mustella, Risso, Ich. Nice, p. 120.

Onos mustella, Risso, Eur. Mérid. iii, p. 215.

Motella tricirrata, Nilss. Prod. p. 48, and Skand. Faun. iv, p. 586; Jenyns, Manual, p. 449; Nordm. in Demid. Voy. Russ. Mérid. iii, p. 531, Poiss. pl. xxvi, f. 1; White, Catal. p. 93; Swainson, Fishes, ii, p. 301; Thompson, Nat. Hist. Ireland, iv, p. 186; McCoy, Ann. Nat. Hist. vi, p. 404; Günther, Catal. iv, p. 365; Collett, Norges Fiske, p. 121; Giglioli, Pesc. Ital. p. 37; Moreau, Poiss. France, iii, p. 268.

Motella maculata, part, Günther, Catal. iv, p. 366.

Three-bearded rockling, Couch, Fish. Brit. Isles, iii, p. 105, pl. cxlix.

(*Young.*) Plate LXXXIX, fig. 3.

Gadus argenteolus, Mont. in Wern. Mem. ii, p. 449; Flem. Brit. Anim. p. 193; Jenyns, Man. p. 451.

Motella argenteola, Yarrell, Brit. Fishes (Ed. 1) ii, p. 195, c. fig. (Ed. 2) ii, p. 281 (Ed. 3) i, p. 589; White, Catal. p. 95.

Hypsiptera argentea (pt.) Günther, Catal. iv, p. 386.

Couchia argentata, Günther, Catal. iv, p. 363.

Thompson's midge, Couch, l.c. iii, p. 118, pl. cli, f. 3, 4.

Silvery gade, Couch, l.c. iv, p. 427, c. fig.

B. vii, D. /55-57, P. 16-18, V. 6-7, A. 48-50, C. 21, Cœc. pyl. xii to xx, Vert. 15-16/33.

Length of head $4\frac{1}{2}$ to 5, of caudal fin 9, height of body 7 in the total length. *Eye*—diameters 7 in the length of the head, 2 diameters from the end of the snout, and $1\frac{1}{4}$ to $1\frac{1}{2}$ apart. Head wider than high. Snout obtuse, broad, and rather depressed. Upper jaw the longer: the posterior extremity of the maxilla reaches to beneath or rather behind the hind edge of the eye. *Barbels*—three, one on either side of the snout anterior to the nostrils, and a third at the symphysis of the lower jaw. *Teeth*—cardiform in both jaws, with the inner row largest in the lower, and the outer in the upper: in a patch upon the vomer:

none on the palatines or tongue. *Fins*—the first dorsal commences above the posterior end of the opercle, extending to above the last third of the pectoral: the length of its base equals half that of the head. Although the usual number of cœcal appendages was twelve, I have found them increased up to 20. *Colours*—of a light chestnut or reddish-chestnut, becoming lighter or even white beneath. A number of black spots or blotches on the upper surface of the head, cheeks, back, and sides of the body, and usually also present on the dorsal and pectoral fins. Montagu observes that these black spots do not appear until the fish attains to 6 or 7 inches in length, up to which time they may be *Mustela alia*, Ray. But Thompson obtained from Strangford Lough a spotted example, $3\frac{3}{4}$ inches long, only those under 3 inches being unspotted.

All my examples have proved to be males: so were Thompson's. Dr. Günther considers some skins from our coasts, which agree with mine, as pertaining to *M. maculata*, they differ from the other British examples in possessing an outer row of stronger teeth in the upper jaw, but are otherwise similar. Such as have no outer enlarged row of teeth in the upper jaw, he considers *M. tricirrata*. At the end of May, 1881, I received from Mr. Dunn some beautiful examples of the young of this fish captured at Mevagissey, they were up to $1\frac{1}{4}$ inches in length. Length of head 1/4 of the total: upper surface of the head flat: eyes 1 diameter apart. The end of the ventral fin deep black, and also a black axillary spot.

Varieties.—Mr. Dunn observes that the most beautiful variety off Mevagissey is captured in thirty or forty fathoms of water. It is of a general cream colour, with the spots of an intense black.

Names.—Termed *whistler* or *whistle-fish* (? *weasel-fish*, Yarrell) in the west of Cornwall. Also locally called *sea-loach*, *three-bearded cod*, and *three-bearded gade*: *gossat*, Folkestone: *St. Mary's trout*, Penrhyn. *Ronst dwrone*, Irish: *slippery-Jemmy*, Dalkey, Dublin Bay. *La Motelle a trois barbillons*, French.

Habits.—Ground feeder. It frequents rocky shores and shallow water, but one was taken in August, 1867, off Folkestone in 30 fathoms of water, and it has been found in stomachs of fish taken at 40 fathoms. Obtained where sea-weeds cover oozy ground, retiring under a stone. It feeds principally on crustaceous animals and small fish, while it is particularly partial to the cuttle.

Means of capture.—Often taken with a bait, as it is very voracious. It makes a rush at its food and twists itself round it.

Breeding.—Thompson found the milt highly developed in two male examples he received from Donaghadee in October. Parnell observes that it sheds its spawn in January and February. At the end of winter Couch has known it large with spawn, also in April.

As food.—Said to be good and formerly much esteemed in Cornwall at genteel tables, but now it is not much employed except by the poor, as a few hours after death its odour is anything but pleasant.

Habitat.—West coast of Norway, shores of the North Sea, European coasts of the Atlantic, and throughout the Mediterranean.

Of this fish a single example has been taken at Stromness (W. Baikie): it is generally rare on the east coast of Scotland but has been recorded from the Moray Firth (Harris, Zool. ix, 1851): the young from Banff (Edward): Aberdeen (Sim): Firth of Forth rare, much more so than the five-bearded form (Parnell): near Carlisle (Yarrell): resident and common off Yorkshire (Yorkshire Vertebrata): Norfolk estuary (Plowright), and one example at Sherringham (Gurney): Folkestone (Buckland): not rare at Weymouth (P. Gosse): Exmouth and Devonshire and Cornish coasts (Montagu): very common in the latter county in rock pools (Cornish). I have frequently obtained it from Brixham and near Penzance. Bangor (Buckland): from near Chester (Willughby).

In Ireland it is taken sparingly round the coast (Thompson): abundant in Dublin Bay where it is chiefly caught on conger lines taking a herring bait. At Belfast rare (Templeton): recorded from Down, Antrim, and Donaghadee, and is said to be very common in Roundstone Bay, Connemara (McCoy).

The example figured is a male, 13 inches long, from Penzance. Fleming has recorded specimens up to 18 inches in length, Pennant to 19, and Thompson to 20.

4. **Motella macrophthalma,** Plate LXXXIX, f. 2.

Motella macrophthalma, Günther, Ann. and Mag. Nat. Hist. 1867 (3) xx, p. 290, pl. v, f. B and l. c. 1874 (4) xiii, p. 139.

B. vii, D. /55, P. 15, V. 6, A. 55, C. 32.

Length of head $4\frac{1}{2}$, of caudal fin 7, height of body $7\frac{1}{4}$ in the total length. *Eye*—diameters 4 to $4\frac{1}{4}$ in the length of the head, 1 diameter from the end of the snout, and 1 apart. The greatest height of the head rather exceeds one half of its length. *Barbels*—three, two on the snout and one beneath the symphysis of the lower jaw. *Teeth*—cardiform in the jaws with an outer enlarged row of widely separated ones in the lower jaw, and in a patch on the vomer: none upon palatines or tongue. *Fins*—the first dorsal commences above the middle of the opercle and extends to above the last third of the pectoral fin, the length of its base equals 2/3 of that of the head. Vent situated at 1/3 of the distance between the front edge of the eye and the posterior extremity of the caudal fin. *Colours*—brownish becoming lighter on the sides and beneath: the smaller example shows traces of what may have been cross-bands.

This species, instituted from young examples, is very similar to *M. cimbria*, but deficient in one of the barbels as well as possessing an excess of about 5 dorsal and 11 anal rays.

Habitat.—One example is 3 inches in length taken at eighty fathoms depth, the other nearly $4\frac{1}{2}$ inches long, and figured life size, captured at a similar depth between Shetland and Faroe.

Genus VII—Raniceps, *Cuvier.*

Batrachoides, Lacép.

Branchiostegals seven: pseudobranchiæ absent. Head large and depressed, body of moderate length, compressed, and somewhat tapering posteriorly. Cardiform teeth in the jaws mixed with some larger ones, also cardiform ones on the vomer, but none on the palatines. Two dorsal fins, the first of which is rudimentary: anal similar to second dorsal: caudal distinct. Ventral with six rays. Minute scales on the body. Air-bladder present. Pyloric appendages rudimentary.

Geographical distribution.—Coasts of northern Europe, extending to the south of Great Britain and Atlantic shores of France.

1. **Raniceps raninus,** Plate XC, fig. 1.

Barbus minor, Ray, p. 164, f. 8; Couch, Linn. Trans. xiv, p. 75. *Least hake*, Pennant, Brit. Zool. (1776) iii, p. 195 (Ed. 1812) iii, p. 261, and *Trifurcated hake*, (1776) iii, p. 196, pl. xxxii, *Trifurcated tadpole fish* (Ed. 1812) iii, p. 272, pl. xxxviii. *Le trident*, Bonn. Atl. Ich. p. 51, pl. lxxxvi, f. 361.

Blennius raninus, Linn. Syst. Nat. (Ed. 10) p. 258; Gmel. Linn. p. 1183.

Blennius raninus et *fuscus*, Müller, Prod. p. 43.

Blennius trifurcatus, Shaw, Zool. iv, p. 174; Turton, p. 93.

Gadus raninus, Müll. Zool. Dan. t. xlv; Brünn. Dansk. Vid. Selsk. Skr. xii, p. 291.

Gadus fuliginosus, Walb. in Schrift. Ges. Nat. Freund. Berl. v, 1784, p. 107.

Gadus trifurcus and *minimus*, Walb. Art. iii, pp. 139, 143.

Phycis fusca and *ranina*, Bl. Schn. p. 57.

Blennius Raii, Bl. Schn. p. 171.

Batrachoides blennioides, Lacép. ii, pp. 451, 456.

Blennius tridactylus, Lacép. ii, p. 484.

Raniceps trifurcatus, Flem. p. 194; Jenyns, p. 453; Yarrell, Brit. Fish. (Ed. 1) ii, p. 204, c. fig. (Ed. 2) ii, p. 292 (Ed. 3) i, p. 598; Parnell, Wern. Mem. vii, p. 359, t. xxxvi, and Fishes Firth of Forth, p. 199, pl. xxxvi; Thompson, Nat. Hist. Ireland, iv, p. 188; Günther, Catal. iv, p. 367; McIntosh, Fish. St. Andrew's, p. 179; Moreau, Poiss. France, iii, p. 275.

Raniceps jago, Fleming, p. 194.

Raniceps niger, Nilss. Prod. p. 50, and Skand. Fauna Fisk. p. 594; Fries and Ekstr. Skand. Fisk. p. 92, pl. xxi.

Batrachocephalus blennioides, Holb. Göth. Vet. Sœllsk. N. Handl. iii, p. 39, c. fig.

Raniceps fuscus, Kröyer, Dan. Fiske, ii, p. 231, c. fig.: White, Catal. Brit. Fish. p. 96.

Raniceps raninus, Collett, Norges Fiske, p. 125; Winther, Ich. Dan. Mar. p. 34.

Lesser fork-beard, Couch, Fish. Brit. Isles, iii, p. 122, pl. clii.

B. vii, D. 3/65-67, P. 20-23, V. 6, A. 57-60, C. 35.

Length of head 4, of caudal fin 8, height of body $4\frac{1}{4}$ in the total length. *Eye*—diameters $5\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and $1\frac{3}{4}$ apart. The general appearance of the fish is well conveyed by its trivial name of "tadpole fish," its body anteriorly being broad and depressed, while posteriorly it is strongly compressed. Upper surface of the head slightly convex or almost flat: cheeks inflated: snout somewhat overlapping the upper jaw, which is slightly longer than the lower: the posterior extremity of the maxilla reaches to about 1/2 a diameter of the eye posterior to the orbit. *Teeth*—cardiform in both jaws, those forming the outer row being enlarged and placed some distance asunder: in a transverse patch on the vomer: none on the palatines or tongue.

Fins—the first dorsal, which is situated over the base of the pectoral, is small and low: just behind it commences the second dorsal, which is highest in its second third and not joined posteriorly to the caudal. Ventral inserted on the throat some distance anterior to the base of the pectoral. Anal commences beneath the ninth or tenth dorsal ray. Caudal rounded. *Scales*—minute. *Lateral-line*—most distinct in the anterior portion of the body, where in some examples a row of light coloured tubercles exist, or else between the lateral-line and the pectoral fin. The stomach has much the shape figured as pertaining to *Gadus virens*, plate lxxxiv, with two very short cœcal appendages as seen in the figure of *Pluronectes limanda*. *Air-bladder*—large, transversely constricted slightly behind the middle and dividing anteriorly into two horn-like prolongations. *Colour*—brown tinged with lilac, becoming of a dirty white beneath, where it is also very faintly coloured with lilac: lips white: fins nearly black, the outer edge of the dorsal anal and upper third of the caudal white. Ventrals paler than the other fins.

Varieties.—Johnston observed that its body when only recently dead was everywhere smooth, after laying three days on a plate it became shrivelled, and an obscure row of tubercles were seen, passing backwards from the pectoral fins, and these form the only good distinction between *R. trifurcatus* and *R. jago* of Fleming, in the first the lateral-line being said to be tuberculated, but in the latter smooth.

Names.—*Tommy noddy*, Cornwall. *Paddock*, Scotch.

Habits.—Apparently solitary, and probably a wanderer. Couch remarked that he had known it taken in August, early in September, in January, and in April. Mr. Waud took it in Essex in May, and one at Kirkwall in June.

Ogilby observes (Zool. 1876, p. 4903) that "the curious fact of this fish being generally washed ashore dead, would seem to prove that it lives at the bottom in very deep water where neither nets nor lines can be used, and where it is perhaps not so rare as is supposed." Remains of echini have been found in their stomachs: as have likewise small insects and soft marine animals, also fish scales believed to have belonged to a sprat.

Means of capture.—In Dublin Bay is generally taken on spitted lines set near the rocks for cod and whiting: in Cornwall mostly in crab-pots.

Baits.—Thompson's fish was taken on the wreck of a ship by a whiting-line, the hook baited with a lug worm, *Arenicola piscatorum*, for whiting-pout.

Breeding.—April (Parnell), July (R. Couch). In Mr. Thompson's fish taken October 8th, the "ova were contained in two small lobes, each about an inch in length." Mr. Gatty obtained a young example from Great Yarmouth, and Newman several of a small size from among some sprats. Mr. Dunn has taken very small ones from the stomachs of other fishes.

As food.—Its extremely unpleasant smell when fresh prevents its being used for this purpose.

Habitat.—Coasts of northern Europe, extending to the south coast of the British Isles. Is very rarely taken on the Atlantic shores of France.

June 24th, 1876, one, 8 inches long, was found at Kirkwall, Orkneys, in a dying condition off the pier head (J. Bruce, Zool. p. 5049). Several known to have been found off Banffshire (Edward): Aberdeen (Sim): Firth of Forth (W. Thompson): St. Andrew's (McIntosh): Berwickshire and Northumberland and west of Scotland (Johnston). It has been taken twice at Redcar (Yorkshire Vertebrata): Mr. Plowright records it from the Norfolk estuary, a few off Cromer (Gurney), and Sherringham, January 29th, 1846 (Rev. S. Dowell): an example was taken in Norfolk in February, 1843 (Gurney, Zool. 1844, p. 532): one at Sherringham on rock-cod lines in 1846 (H. Frere, Zool. p. 1264): another 4½ inches long in the river Crouch in Essex, in May, 1858 (S. W. Waud): Newman in the Zoologist, in 1855, stated that he had observed among the sprats brought to Billingsgate market an occasional specimen of this fish. On October 8th, 1853, one 9½ inches in length was taken at Weymouth (W. Thompson). I saw a local example in Mr. Rowe's collection at Plymouth, and on September 3rd, 1881, Mr. Dunn sent me one from Mevagissey. April 17th, 1863, Mr. Cornish reported in the Zoologist (p. 8642) one from Mount's Bay, in 1864 three more

from the same locality, and in 1866 two more. The same authority remarked in 1872 (Zool. p. 2947) on having obtained one from Penzance, the first he had seen for years, another in 1876 (Zool. p. 5128), taken about a mile from shore on a rocky bottom : and a small one in 1878, which was observed splashing about in a hole, a stem of sea-weed was thrust in, this the fish laid hold of and was dragged out by it (Zool. p. 109). They are occasionally taken by trawlers in Mount's Bay. Somersetshire (Baker). It was first described from an example taken at Beaumaris, in Wales, by Mr. Davies.

In Ireland Thompson recorded an example, 10½ inches long, picked up on September 21st, 1837, as it lay floating off Donaghadee Harbour, county Down : Dingle Bay, county of Kerry (W. Andrews) : Dalkey Sound (Sir J. Corrigan). Blake-Knox (Zool. 1866, p. 508) observing upon the fishes of Dublin Bay, says, occurs sparingly here in autumn and winter and is not nearly so rare as *Phycis blennoides:* on March 15th, 1876, one 8½ inches long was picked up dead at Portrush (Ogilby, Zool. p. 4753).

The example, figured life size, came from Sussex, and I am indebted for it to Mr. Carrington, F.L.S., of the Royal Westminster Aquarium. Pennant records one from Beaumaris, which measured 12 inches in length.

Genus VIII—Brosmius, *Cuvier.*

Branchiostegals seven: pseudobranchiæ absent. Body moderately elongated, and posteriorly compressed. A barbel below the chin. Teeth cardiform, present in the jaws, vomer, and on the palatine bones. A single long dorsal and a single anal fin, which are distinct from the caudal. Ventral with five rays. Scales small.

Geographical distribution.—In Europe from the polar region as far south in the North Sea as off Yorkshire: while in the western hemisphere it extends as low as to Cape Cod.

Brosmius brosme, Plate XC, fig. 2.

Brosme, Ström. Söndm. i, p. 272, t. i, f. 19; Pontopp. Norg. Nat. Hist. ii, p. 207. *Torsk*, Pennant, Brit. Zool. (Ed. 1776) iii, p. 203, pl. lxxxix (Ed. 1812) iii, p. 269, pl. lxxxvii; Ascan. Icon. ii, p. 7, t. xvii. *The Torsk-fish*, Low, Fauna Orcad. p. 200.

Gadus brosme, Müll. Prod. Zool. Dan. p. 41; Shaw, Zool. iv, p. 161; Fabr. Faun. Grœnl. p. 149; Gmel. Linn. i, p. 1175; Lacép. ii, p. 450; Bl. Schn. p. 9; Donovan, Brit. Fish. iii, pl. lxx; Turton, Brit. Fauna, p. 92; Faber, Fische Isl. p. 84.

Gadus torsk, Bonn. Atl. Ich. p. 51, pl. lxxxvii, f. 362.

Gadus lubb, Euphras. Vet. Akad. Handl. 1794, p. 223, t. viii.

Blennius torsk, Lacép. ii, p. 508.

Enchelyopus lub and *brosme*, Bl. Sch. p. 51.

Brosmius vulgaris, Flem. Brit. Anim. p. 194; Jenyns, Manual, p. 452; Yarrell, Brit. Fish. (Ed. 1) ii, p. 197, c. fig. (Ed. 2) ii, p. 285 (Ed. 3) i, p. 591; Nilss. Skan. Fauna, iv, p. 597; Kröyer, Dan. Fiske, ii, p. 215, c. fig.; Parnell, Wern. Mem. vii, p. 357, and Fish. Firth of Forth, p. 197; Malgren, Wiegm. Arch. 1864, p. 297; Storer, Fish. Mass. p. 136; De Kay, New York Fauna, Fish. p. 289, pl. xliv, f. 143; Thompson, Natural History of Ireland, iv, p. 186; Goode and Bean, P. U. S. Nat. Mus. i, p. 362.

Brosmius Scotica, Swainson, Fishes, ii, p. 301.

Brosmius brosme, White, Catal. p. 95; Gill, Proc. Ac. Nat. Sc. Phil. 1863, p. 242; Günther, Catal. iv, p. 369; McIntosh, Fish. St. Andrew's, p. 179; Collett, Norges Fiske, p. 125; Winther, Ich. Dan. Mar. p. 35.

Brosmius Americanus, Gill, l. c. p. 242.

Torsk, Couch, Fish. Brit. Isles, iii, p. 96, pl. cxlvii.

B. vii, D. (85)90-100,* P. 21-23, V. 5, A. (62)71-76, C. 35.

Length of head 5, of caudal fin 9 to $9\frac{1}{2}$, height of body 8 in the total length. *Eye*—diameters $4\frac{1}{2}$ in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and 1 apart. Interorbital space nearly flat. The snout somewhat projects beyond the upper jaw which last is slightly longer than the mandibles. The maxilla reaches posteriorly to beneath the middle of the eye. Rather a deep furrow extends from the occiput to the base of the dorsal fin. A short barbel beneath the chin. *Teeth*—cardiform, with an inner row in the lower jaw the largest: while there exist some still larger ones mixed with cardiform ones on the vomer and palatines: tongue toothless. *Fins*—the fins-rays in the fresh examples are very difficult to count, owing to their being covered by skin; the dorsal commences above the middle of the pectoral and is continued at nearly the same height almost to the base of the caudal fin. The anal commences on a line beneath about the thirty-fifth dorsal ray. Ventrals broad, thick, ending in

* Donovan shows only forty-five rays in the dorsal fin, and thirty-seven in the anal, and gives the same numbers in his text. In this he appears to have been copied by Fleming and Jenyns, while the error has been continued through the three editions of Yarrell's British Fishes.

points. *Scales*—minute. *Colours*—upper portion of the head and body grayish, tinged with bronze or yellow, and becoming lighter on the sides and beneath. Outer edge of dorsal, anal, pectoral, and caudal having light outer margins with a dark base.

Names.—The Torsk is likwise termed *Tusk* and *Brismak* in the Shetlands, also the *cat-fish*. Bloch observed that the "torsk" of the Baltic is *Gadus callarias* or the young of the codfish (see page 277), the term *torsk* in Scandinavia being applied to several species of codfishes. This fish is known in Massachusetts, America, as *cusk*.

Habits.—Off northern Europe Faber observed that it approached the land in schools early in the year, retiring to the deep late in the summer. It resides at great depths, preferring a rocky bottom. From the middle to the end of April, 1881, large shoals of these fishes were found following in the track of the herrings, during the spring herring-fishery off Sweden (Land and Water, May 7th). The food of this fish is much the same as that of the cod and ling, while in those brought up from considerable depths the same phenomenon of an empty stomach or these organs protruding out of the mouth may be perceived. Among several examined, in the stomach of one was found a good sized haddock, two small flounders, a buckie (with a hermit crab inside it) and some corallines: while in some of the others were crustaceans and small fish. Mr. Brotherston (Land and Water, March 5th, 1881) alludes to the contents of the stomach in one sent to him for preservation on February 19th. The fish was 3 ft. in length, and weighed 20 lb. (the largest of three captured at the same time was 3 ft. 4 in. in length). In Yarrell's British Fishes it is said, on the authority of Faber, that "nothing is ever found in the stomach; and this has probably given rise to the saying that it lives on the juice of sea-weeds. The contents of this one's stomach—part of which I send for your inspection—is therefore interesting. It appears to me to be roe. The 'roe' was mixed with a dirty bluish thick liquid. A large fishhook, $3\frac{1}{4}$ in. in length, was also found in it."

Means of capture.—Similar to such as are employed for cod and ling, by means of long- and hand-lines, but with rather smaller hooks. In January, 1880, the Torsk fishery was late for the season off Denmark, but large quantities of fish came close to the coast and were readily netted. This fishery in Norway was undertaken due to Sars' discoveries, and enormous masses of these fish were discovered in the fiords surrounding the island of Spitzbergen, on the western shores of which upon some banks, eight to ten fathoms in depth, they were so plentiful that they could easily be drawn on board with hand nets.

Breeding.—In northern seas it is observed to breed in April and May among the *fuci*.

Diseases.—Is liable to be affected by parasitic worms which form a *nidus* in its skin producing rounded swellings. It is frequently thrown up dead in large numbers after storms on the coast of the Faroë Islands, and off the south coast of Iceland.

As food.—According to Low it is one of the best of cured fish, swells much in boiling, and parts into very thick flakes: eaten fresh it is very firm, and rather tough, which induces most people to prefer it salted. Pontoppidan observes that the hard roe is well flavoured.

Habitat.—Its normal range in Europe is from Spitzbergen to about the 60° N. lat. Abundant off Spitzbergen, Finmark, Norway, and among the Faroës, as well as on the west and south (rarely on the north and east) coasts of Iceland. It is found likewise on the northern point of Denmark and extends, but in greatly diminished numbers, southwards in the North Sea as far as Yorkshire. In the western hemisphere it is present from the Polar regions to Cape Cod.

In the seas about Shetland it swarms along with the ling, and either barrelled or dried forms a considerable article of commerce, but it becomes more scarce about the Orkneys (Low): it has been recorded from Wick, off which coast it is frequently captured some fifty miles to the north-east in

about fifty fathoms of water, at a locality termed Skate Hole, due to the abundance of these fish. Donovan also mentions it off Caithness: Banff common (Edward): Aberdeen (Sim): at St. Andrew's not common (McIntosh): said to be occasionally taken in the Firth of Forth and brought to the Edinburgh market, where the young of the ling is frequently mistaken for it (Parnell). It has been captured at Whitby (Ferguson, 1860) also it has been recorded more than once from Yorkshire during the season of 1880-81, while Mr. Mudd, of Great Grimsby, informs us that it is frequently taken near the coast (Yorkshire Vertebrata).

Respecting its occurrence in Ireland, Thompson observes that it is said by M'Skimmin in his History of Carrickfergus to have been taken on the coast.

The specimen figured is 17 inches in length and in the British Museum. The average length of the torsk is said to be about 18 inches: Low, however, mentions one 42 inches long. An example was captured at Faaboorg on the south coast of the island of Fühnen, in 1880, which weighed 42 lb., the roe alone weighing 7 lb.

Family, II—OPHIDIIDÆ, *Müller.*

Pseudobranchiæ present or absent. Body elongated. Gill-openings wide, and the membranes not attached to the isthmus. Eyes of moderate size, rudimentary or absent. Barbels present or absent. Vertical fins usually confluent, without any anterior dorsal or anal. The dorsal occupies the greater portion of the length of the back. Ventrals, when present, rudimentary and jugular. Scales and air-bladder present or absent. The vent may be at the throat. Pyloric appendages, if present, in small numbers.

Geographical distribution.—Mostly deep sea and cosmopolitan forms, but some are littoral, and one at least has been found in the waters of the subterranean caves in Cuba.

First Group.—Ophidiidæ.

Ventral fins in the form of a pair of bifid filaments inserted below the throat.

Genus I—Ophidium (*Artedi*), *Cuvier.*

Branchiostegals seven: pseudobranchiæ present. Body elongated and compressed. Villiform or cardiform teeth in the jaws, vomer, and palatine bones. Gill-openings wide: gills four. Dorsal, caudal, and anal fins low and continuous: ventral in the form of a pair of bifid filaments inserted below the throat. Vent situated considerably posterior to the insertion of the pectoral fin. Scales small, covering the body. Air-bladder present. Pyloric appendages absent.

Geographical distribution.—Littoral species, distributed through the Atlantic and Pacific Oceans, also the Mediterranean.

1. Ophidium barbatum, Plate XCI, fig. 1.

Ophidium, Plin. iii, cap. 9, 11; Rondel. xiv, c. 2, p. 397; Gesner, pp. 91, 104; Aldrov. iii, c. 26, p. 353. *Grillus*, Belon. De Aquat. pp. 132, 133. *Ophidion*, no. 1, Artedi, Synon. p. 42. *Enchelyopus*, no. 4, Klein, Pisc. Miss. iv, p. 52.

Ophidium barbatum, Linn. Syst. Nat. i, p. 431; Brouss. Phil. Trans. 1781, p. 436, t. xxiii; Bonnat. Atl. Ich. p. 40, pl. xxvi, f. 89; Shaw, Zool. iv, p. 68, pl. vii; Brünn. Ich. Mass. p. 15; Bloch, t. clix, f. 1; Lacép. ii, p. 279; Bl. Schn. p. 484; De la Roche, Ann. Mus. xiv, p. 275; Turton, Brit. Fauna, p. 88; Cuv. Règne Anim.; Flem. Brit. Anim. p. 201; Risso, Ich. Nice, p. 96 and Hist. Nat. Eur. Mérid. iii, p. 211; Müller, Abdh. Berl. Acad. 1843, p. 151, pl. iv, f. 1 (air-bladder); Jenyns, Manual, p. 481; Yarrell, Brit. Fish. (Ed. 1) ii, p. 316, c. fig. (Ed. 2) ii, p. 415 (Ed. 3) i, p. 76; Swainson, Fish. ii, p. 260; Costa, Fauna Nap. var. b, pl. xx; White, Catal. p. 50; Kaup, Apodal Fish. p. 155; Steind. Ich. Span. u. Port. 1868, p. 46; Günther, Catal. iv, p. 377; Giglioli, Pesc. Ital. p. 37; Moreau, Poiss. France, iii, p. 223, c. fig.

Enchelyopus barbatus, Klein, MSS. Pisc. iv, p. 52.

Ophidium vassali, Risso, Ich. Nice, p. 97; pl. v, f. 12, and Hist. Nat. iii, p. 212; Cuvier, Règne Anim. Ill.; Guichenot, Expl. Alger. p. 115; Müller, l.c. p. 150, t. iv, f. 5 (air-bladder); Kaup, Apodal Fish. p. 115; Günther, l.c. p. 378; Canestr. Fauna Ital. p. 190; Steind. l.c.; Giglioli, l.c. p. 37; Moreau, l.c. p. 224.

Ophidium broussonetii and *rochii*, Müll. l.c. t. iv, f. 2 and 3 (air-bladder); Günther, l.c. p. 377; Giglioli, l.c. p. 37.

Bearded ophidium, Couch, Fishes of Brit. Isles, iii, p. 131, pl. clv.

B. vii, D. 130-140, P. 20-23, V. 1, A. 100-120.

Length of head $5\frac{1}{4}$ to 6, height of body $7\frac{1}{2}$ to 9 in the total length. *Eye*—diameters 4 to 5 in the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and $1\frac{1}{2}$ apart. The snout rather overhangs the mouth: the maxilla reaches posteriorly to beneath the hind edge of the eye: the upper jaw is slightly longer than the lower. The greatest width of the head scarcely equals half its length: while its height equals the length of its postorbital portion. The outer ventral filament the longer. *Teeth*—villiform, and of about equal size in the jaws, vomer, and palatine bones. *Fins*—The dorsal commences above the last third of the pectoral fin; and the anal below about the fifteenth dorsal ray: they are both low and conjoined posteriorly to the caudal. *Scales*—small and cycloid, in the example figured none exist upon the head. *Lateral-line*—nearer the dorsal than the abdominal profile. The vent is situated just before the commencement of the anal fin. *Colours*—brownish or gray, sometimes tinged with yellow, vertical fins with or without a black edge.

Varieties.—This species has been divided into several, but we are still in want of evidence whether such are not merely varieties. That the black edge to the vertical fins is no criterion may be seen in the British Museum example of *O. broussoneti*, having such. *O. barbatum* is said to possess two bones, directed downwards, superiorly attached to the first vertebra, and inferiorly to a large crescentic bone, fitting into the front end of the air-bladder, and placed between a pair of thick processes of the fourth vertebra. The lower branch of the outer branchial arch with five or six gill-rakers, and a curved, hook-like process on the end of the ethmoid. *O. broussonetii* with no separate bone fitting into the front end of the air-bladder. The lower branch of the outer branchial arch with four gill-rakers. *O. rochii*, a cuneiform bone at the anterior extremity of the air-bladder, which is contracted anteriorly, and posteriorly having a round foramen merely closed behind by the mucous membrane. *O. vassali*, air-bladder globular, without any bone anteriorly, but possessing the round posterior foramen. The lower branch of the outer branchial arch with four gill-rakers.

Habits.—Unknown. It feeds on small fishes and crustaceans.

Breeding.—In the Mediterranean about the end of the spring.

As food.—It is inferior and coarse.

Habitat.—Along the northern coasts of France, common throughout the Mediterranean and Adriatic. This fish was first included in the list of British forms by Berkenhout, next by Dr. Broussonet in 1781: a single example from our shores appears to exist.

The example figured is from a specimen in the British Museum. It came from Padstow, on the north coast of Cornwall, and is Dr. Günther's type of *O. broussoneti*. It is said to attain to at least 10 inches in length.

Second Group—Fierasferina.

Ventrals absent: vent near the throat.

Genus II—Fierasfer, *Cuvier.*

Echiodon, Thompson. *Diaphasia*, Lowe. *Oxybeles*, Richardson. *Porobronchus*, Kaup (*young*).

Branchiostegals seven: pseudobranchiæ absent. Body ending in a long and tapering tail. Gill-openings wide, the membranes united beneath the throat but not attached to the isthmus. Gills four. The upper jaw overlapping the lower. No barbels. Cardiform teeth on the jaws, vomer, and palatine bones, while canines may likewise be present. Vertical fins continuous: ventrals absent. Vent placed under the throat. Scales, if present, minute. Air-bladder present. Pyloric appendages absent.

Kaup described (Ann. Mag. 1860, vi, p. 272, pl. iii, f. D.) the young of *Fierasfer acus* as the type of a new genus, *Porobronchus*, destitute of pectoral fins.

Some of these fishes seem to be endowed with peculiar habits or those of a "free messmate" seeking its fortune inside the trepang, *Holothuria*, within its digestive canal, or its arborescent respiratory processes which open at the posterior extremity of the body. Dr. Greef, at Madeira, found one residing within a trepang: while Quoy and Gaimard also observed a species inside *Stichopus tuberculosus*. Professor Emery, of Naples, has also remarked upon how this fish, when in the tanks in the Aquarium, works itself into a *Holothuria*, going in tail foremost as if to be able to readily emerge when appropriate food were present near the outlet.

Geographical distribution.—Cosmopolitan in temperate and tropical seas.

1. Fierasfer dentatus, Plate XCI, fig. 2.

Fierasfer dentatus, Cuv. Règne Anim.; Kaup, Apodal Fish, p. 158; Yarrell, Brit. Fish. (Ed. 3) i, p. 82, c. fig.; Günther, Catal. iv, p. 383; Emery, Faun. Nap. p. 3.

Echiodon Drummondii, Thompson, Proc. Zool. Soc. 1837, p. 55, Trans. Zool. Soc. ii, p. 207, pl. xxxviii, and Nat. Hist. Ireland, iv, p. 231; Yarrell, Brit. Fishes (Ed. 2) ii, p. 417; Bonap. Pisc. Eur. p. 41; White, Catal. Brit. Fish. p. 51; Giglioli, Pesc. Ital. p. 37.

Drummond's echiodon, Couch, Fish. Brit. Isles, iii, p. 133, pl. clvi.

B. vii, D. 180, P. 16, A. 180, C. 12, Vert. 98.

Length of head $9\frac{1}{2}$, height of body 14 in the total. *Eye*—diameters $4\frac{1}{2}$ in the length of the head, 1 diameter from the end of the snout, and 1 apart. Width of the head equal to 2/7 of its length: several rows of open pores on its surface. Nostrils large, situated just in front of the centre of the eye. Mouth obliquely cleft. *Teeth*—cardiform, in the upper jaw anteriorly two (or rarely one) pairs of canines: in the lower jaw one or sometimes two pairs, the differences in numbers being frequently due to one or more teeth having been broken off. *Fins*—the dorsal commences slightly in advance of the base of the pectoral fin, its rays highest posteriorly. Central caudal rays the longest. Fin rays articulated, but none branched. Vent below the base of the pectoral fin. *Scales*—apparently absent. *Lateral-line*—consisting of a depression extending along the whole length of the side, anteriorly above, and posteriorly in the middle of its depth. *Colours*—reddish, with the sides dotted, and the outer edges of the fins blackish.

Habits.—Of these but little are known.

Habitat.—South coast of Ireland, Mediterranean to the Italian shores.

Thompson, in June, 1836, obtained one 11 inches long, which was found dead on the beach at Carnlough, near Glenarm, in the county of Antrim, after a strong easterly wind. A second example, 8 inches in length, was found on the shore of the harbour of Valencia, county of Kerry, about February, 1852.

The figure is from Thompson's original illustration.

Third Group.—Ammodytina.

Ventral fins absent. Vent placed far from the head.

Genus III—Ammodytes,* *Artedi.*

Hyperoplus and *Bleekeria*, Günther.

Branchiostegals seven or eight: pseudobranchiæ in the form of lamellæ. Body low, elongated and compressed. Gill-openings very wide, the gill membranes not being united. Gills four. Eyes of moderate size. Barbels absent. Lower jaw usually prominent. Teeth, when present, minute. A single long dorsal fin composed of articulated rays. Scales, if present, small: when absent, the skin of the abdomen may be vertically folded. Lateral-line present. Air-bladder absent. Vent remote from the head.

Geographical distribution.—Littoral and gregarious forms mostly of a small size, which frequent the sandy shores of Europe and North America as far south as Cape Hatteras; while the late Dr. Jerdon discovered a species off Madras.

Of the three British species, only a solitary example of *A. siculus* is said to have been dredged off the Shetland Isles, and is now in the British Museum: whereas *A. lanceolatus* and *A. tobianus* are common in suitable localities, but being very similar in appearance it often becomes difficult to decide to which of the two forms some authors are alluding. I therefore propose bringing together in this place published accounts of the habits of the sand-eel or sand-launce generally. In May, 1870, Sars, when investigating the cod-fisheries off the coast of Norway, had his attention directed to the large number of schools of sand-eels which during the winter months appear to reside in deep waters, as throughout those months they are occasionally taken from the stomachs of deep-sea fishes. As summer sets in they arrive in dense schools in the sandy bays and sounds, the places they frequent having been known from time immemorial, and being often very limited in extent. Exceedingly voracious, they devour any fish or other animal which they are able to overcome, persistently pursuing the schools of sprats, while they likewise bury themselves in the sand, provided the weather is not too bright and sunny, consequently when the tide is out they may be dug up at even some considerable distance from the receding sea, although within the limits of tide-marks. Mr. Lloyd mentions that two kept in an aquarium at Hamburg always buried themselves in the sand at a particular spot, and on being stirred up they swam about with an uneasy and rapid wriggling motion for a few moments, generally with their heads towards the light, and then dashed down into the sand into which they disappeared, prior to the subsidence of the little cloud of sand which they raised in the act of vanishing.

They appear to live in large schools which have been observed to rise to the surface simultaneously, or when driven there by predacious fishes. Thus Sars records seeing a flock of sea-gulls sitting listlessly on the edge of a rock overhanging the sea: suddenly, and as if with one impulse, all rose at the same moment and screaming in concert, winged their way to a distant point where the sea looked like a miniature whirlpool. This was occasioned by the pollack, *Gadus pollachius*, which had surrounded a school of sand-eels, and forced them towards the surface, when they became an easy prey, not only to these fish but to the gulls which swooped down from above. Porpoises have been recorded to act much in the same way, swimming round the schools and devouring immense numbers. Their appearance when thus rising has often been mistaken for schools of mackerel.

A. *Vomer armed anteriorly with a pair of tooth-like projections.*

1. Ammodytes lanceolatus, Plate XCII, fig. 1.

Ammodytes, Jago, Ray, Syn. p. 165, t. ii, f. 12. *Enchelyopus*, Klein, Pisc. Miss. iv, p. 56, no. 7, t. xii, f. 10.

* The term Ammodytes refers to its powers of digging in the sand.

Ammodytes tobianus, pt. Bl. t. lxxv, f. 2; Turton, Brit. Fauna, p. 87; Bonnat. Atl. Ich. p. 39, pl. xxvi, f. 88; Cuv. Règne Anim.: Jenyns, Manual, p. 482; Yarrell, Brit. Fish. (Ed. 1) ii, p. 317, c. fig. (Ed. 2) ii, p. 424 (Ed. 3) i, p. 89; Faber, Fische Isl. p. 63; Parnell, Wern. Mem. vii, p. 390, and Fish. Firth of Forth, p. 230; ? Nilss. Skan. Fauna, iv, p. 653; Kröyer, Dan. Fisk. iii, p. 574, c. fig.; Thompson, Nat. Hist. Ireland, iv, p. 235; White, Catal. p. 114.

Ammodytes lanceolatus, Lesauvage, Bull. Sc. Nat. 1825, iv, p. 262; Günther, Catal. iv, p. 384; Collett, Norges Fiske, p. 126; Winther, Ich. Dan. Mar. p. 35; Moreau, Poiss. France, iii, p. 217.

Larger launce, Couch, Fish. Brit. Isles, iii, p. 140, pl. clvii, f. 2.

B. vii, D. 53-58(61), P. 12-13, A. 28-31(33), C. 15, L. l. 190-203, Cœc. pyl. 1, Vert. 67.

Length of head $4\frac{1}{2}$ to $5\frac{1}{4}$, of caudal fin $10\frac{1}{2}$ to 12, height of body 10 to 12 in the total length. *Eye*—situated a little before the middle of the entire length of the head, 2 to $2\frac{1}{4}$ diameters from the end of the snout, and 1 to 2 apart. Upper surface of the head nearly flat: lower jaw the longer, and having a soft prolongation in front: premaxillaries not protrusible. Nostrils nearer eyes than end of snout: the posterior extremity of the upper jaw does not reach to beneath the eye. *Teeth*—absent from the jaws, tongue, and palate: the head of the vomer bifurcates into two tooth-like processes which project downwards and slightly outwards. *Fins*—dorsal low, and with an even upper edge: it commences on a line a little posterior to the hind edge of the pectoral fin, which latter is short, being only equal to about $3\frac{1}{2}$ or 4 times in the length of the head. Caudal forked. *Scales*—small, present over the body. *Lateral-line*—commences a little behind the head, is continued a short distance below, but parallel with, the dorsal profile, and from it 190 to 203 folds of skin pass obliquely downwards. A second lateral-line runs from the lower part of the base of the pectoral fin along the body to a short distance above the base of the anal fin. A straight line, due to muscular insertions, passes from the head to the centre of the base of the caudal fin. *Colours*—olive green, divided a little above the middle of the depth of the body, by a broad bright band, from a silvery abdomen. Dorsal and anal fins colourless: caudal with a dark base, and the central rays nearly white. A black blotch on the side of the upper jaw extending on to the cheek.

M. Lesauvage, of Caen, was the first who distinctly pointed out the distinction between the greater and lesser sand-eel.

Names.—Coast of Down, in Ireland, termed *Snedden*. *Horners*, or *horn-eels*, Edinburgh: *greater sand-eel*, Yorkshire: *great lant*, Cornwall. At St. Ives the fishermen term the adult *snake-bait*, and the young *naked-bait*: used to be termed *smoulds* in Norfolk (Browne). Yarrell suggested that the larger sand-eel only should be termed *sand-eel* and the lesser one *sand-launce*. *Le lancon*, French.

Habits.—These are similar to what have been observed under the head of the genus (page 329), but as a rule this form keeps in deeper water than *A. tobianus*, while it is much more voracious; from the stomach of the one figured, which was 12 inches in length, I took seven sprats from 1 to $2\frac{1}{4}$ inches long, and a lesser sand-eel 3 inches long. This fish does not object to devour its own kind. Mr. Dunn sent me one, 5 inches long, taken from the stomach of one a little longer. It appears to have derived its name "horn-eel" from the sort of horny tip at the end of its lower jaw, which assists it when diving down into the sand, where it conceals itself during the ebb of the tide. Thompson remarks how he observed a number of pigs at Newcastle, county of Down, daily frequenting the sand at the extreme edge of the retiring waves, and ascertained that they were in search of these fishes. It has, however, been recorded as captured at the entrance of the British Channel, thirty miles from land and in forty-five fathoms of water. Frequently taken from the stomachs of larger fish.

Mode of capture.—The fishery at St. Ives, in Cornwall, commences in May and lasts until September. Thompson remarked as follows: at Dundrum, on the coast of Down, from the loose sand covered with water, to about the depth of 9 inches, the persons engaged in this occupation with great dexterity drew these

fishes from their hiding-places, using for this purpose old reaping-hooks. These are run through the sand with the right hand drawn towards the left, by which the fish is seized and transferred to a basket, strapped round the waist and carried in front. It is in shape like the angler's, but much larger and open at the top. Fishing here is daily carried on throughout the year except in winter, when being full of spawn they are rejected as food. In some places they are sought for by moonlight, and it has been said that their silvery brilliancy is more striking by night than by day. A rake is used in some parts, or a strong piece of iron wire bent into a sickle shape.

A writer (Old Log) in the Field (June 18th, 1881) mentions that "when going fast through the water to get over some very unpromising ground, and our baits were nearly at the top of the water, I felt a very light bite, and, drawing in my line, found that I had got hold of a large sand-eel, whose mouth was little bigger than the baited hook. Now, according to all ordinary rules, the sand-eel should have been in or about the sand at the bottom, and yet he was foraging at the surface, and took a Belgian grub (see Pollack, p. 254) which must have been a novelty to him."

Baits.—It appears to like live bait best, and objects to any if in the least tainted.

Breeding.—This may vary in accordance with the seasons in different localities, but I am not disposed to accept some of the statements recorded on this head. In August at St. Ives I found the roe similarly advanced to what I observed in *A. tobianus*, and conclude they both spawn in the autumn and winter months.

As food.—A very delicate dish, especially when in roe, but not good during the winter months, when it is thin and out of condition. It is very good fried with bread crumbs, or even simply boiled.

Uses.—As bait, for which its silvery appearance well adapts it.

Habitat.—From the Atlantic shores of northern Europe and coasts of the German Ocean, and very rarely found in the Mediterranean.

This form, although extended round the British Isles, is not so common as the smaller sand-eel, and seems to prefer deeper water. It is rare in the Orkneys and Zetland (W. Baikie): common off Banff (Edward): Aberdeen (Sim): one example is recorded from the Moray Firth taken from the stomach of a cod: at St. Andrew's it is frequent in the *débris* of storms on the sands, as well as in the latter near low water-mark: bands of young occur in the tidal pools in May (McIntosh): not unfrequent in the Firth of Forth, Berwickshire, and in many situations along the east and west coasts of Scotland (Parnell). In Yorkshire, common, but somewhat local (Yorkshire Vertebrata): common in the Norfolk estuary (Lowe): Suffolk: also along the south coast, as Sussex, Hampshire, Dorsetshire (Yarrell), becoming rarer off south Devonshire and more or less common along Cornwall. Abundant in Guernsey. Somersetshire (Baker).

In Ireland it has been recorded from the north-east and west coasts, also probably in the south, but is rarer than the smaller species, *A. tobianus*.

The example figured is a female, 12 inches long, which I obtained at St. Ives in August, 1881, the ova being nearly mature. Thompson took one in Ireland 11 inches in length: another 13 inches long has been recorded, while Ray's example was $15\frac{1}{2}$ inches.

B. *Vomer unarmed.*

2. Ammodytes tobianus, Plate XCII, fig. 2.

Sandilz, Salv. fol. 70; Aldrov. ii, c. 49, pp. 252, 254; Jonston, i, tit. 3, c. 3, art. 1, t. xxi, f. 1. *Tobianus*, Schonev. p. 76. *Ammocœtus s. Ammodytes*, Gesner, p. 39; Willu. p. 113; Ray, p. 38. *Ammodytes*, Artedi, Synon. p. 29, and Genera, p. 16, Spec. p. 55; Gronov. Zooph. p. 133, no. 404; Schlegel, Dieren Neder. p. 91, pl. ix, f. 4. *Enchelyopus*, Klein, Pisc. Miss. iv, p. 55, no. 6, t. xii, f. 8, 9. *Sand-launce*, Pennant, Brit. Zool. (Ed. 1) iii, p. 156, pl. xxv, no. 66 (Ed. 2) iii, p. 206, pl. xxviii. *The launce*, Low, Fauna Orcad. p. 188.

Ammodytes tobianus, Linn. Sys. i, p. 430; Bl. t. lxxv, f. 2; Shaw, Zool. iv, p. 81, pl. ix; Bl. Schn. p. 493; Gmel. Linn. p. 1144; Donov. Brit. Fish. ii, pl. xxxiii; Lesauvage, Bull. Sc. Nat. 1825, iv, p. 262; Ekström, Fische Mörkö, p. 263; Swainson, Zool. Illus. (series 2) i, pl. lxiii; Fleming, p. 201; Gronov. ed. Gray, p. 159; White, Catal. Brit. Fish. p. 114; Günther, Catal. iv, p. 385; Collett, Norges Fiske, p. 126; Winther, Ich. Dan. Mar. p. 35; Moreau, Poiss. France, iii, p. 218, c. fig.

Ammodytes alliciens, Lacép. ii, p. 274, pl. viii, f. 1; White, Catal. Brit. Fish. p. 115.

Ammodytes lancea, Cuv. Règne Anim.; Jenyns, Brit. Vert. p. 483; Yarrell, Brit. Fish. (Ed. 1) ii, p. 322, c. fig. (Ed. 2) ii, p. 429 (Ed. 3) i, p. 94; Nilss. Skand. Fauna, iv, p. 656; Kröyer, Dan. Fiske, iii, p. 593, c. fig.; Thompson, Nat. Hist. Ireland, iv, p. 237; Parnell, Wern. Mem. vii, p. 391, and Fish. Firth of Forth, p. 94.

Lesser launce, Couch, Fish. Brit. Isles, iii, p. 137, pl. clvii, f. 1.

B. vii, D. 53-59, P. 12, A. 26-30, C. 15, L. l. 125-145, Vert. 62-63, Cœc. pyl. 1.

Length of head $5\frac{1}{4}$ to $5\frac{1}{2}$, of caudal fin $9\frac{1}{2}$ to $11\frac{1}{2}$, height of body $7\frac{1}{2}$ to $9\frac{1}{2}$ in the total length. *Eye*—diameters 6 to 7 in the length of the head, $1\frac{1}{2}$ to $2\frac{1}{2}$ diameters from the end of the snout, and 1 to $1\frac{1}{2}$ apart. Lower jaw projecting some distance beyond the upper, but not so much as in *A. lanceolatus*. The maxilla reaches posteriorly to beneath the hind nostril: the length of the mandible equals 1/3 of that of the head: premaxillaries protractile. Nostrils patent, rather nearer the orbit than to the end of the snout. *Teeth*—none in the jaws: head of vomer forming a somewhat elevated transverse prominence, having a few deciduous teeth posteriorly, also a single similar row along the body of that bone: none on the palatines: a median row along the base of the tongue. *Fins*—dorsal commences above the origin of the last third of the pectoral: the latter fin 2/5 as long as the head. Stomach as in *A. lanceolatus*. *Scales*—small, from 125 to 145 transverse and oblique folds of skin. *Lateral-line*—the superior along the side of the back, the inferior along the side of the lower edge of the abdomen. *Colours*—upper-third of the body olive green, a silvery band, which widens and becomes more distinct posteriorly, passes along the side of the body, one half below, the other half above the median line: below this band the abdomen is white. Fins unstained, except the base of the caudal which is brownish. This fish is more silvery than the last species, and not so dark along the back, its colours having been well likened to those of the atherine, or sand-smelt, with its broad silvery lateral band.

Names.—*Lesser sand-eel*, Yorkshire: *lizard-bait*, by the fishermen at St. Ives. *Ornals*, at Aberdeen (Sim): *the wriggle*, Sussex: *lant*, Cornwall. *Saneels*, Moray Firth. *L'ammodyte équille*, French. *De Smelten*, Dutch.

Habits.—This species appears to congregate in greater assemblages than the large sand-eel, and likewise to be seen more commonly nearer in shore, but it is not rare to find the two forms together.

Its head being small and muzzle sharp, it easily pierces the sand: while the body is square and slender, and so causes no obstruction to its progress: but due to its many enemies it always appears to be desirous of retreating rapidly into the sand. Porpoises, codfish, mackerel, &c., are constantly on the look out for it when the tide is high: and sea-birds when the tide is low.

"The fishers say the sand-eels change their ground, so as to be hardly ever two days at the same place" (Thompson, co. Down): and this form takes to softer ground than the larger species. At the ebb of the tide it buries itself about a foot deep in the sand, remaining concealed there until the succeeding tide; occasionally at low water its snout may be perceived above the sand, or its hiding-place discovered by a little bubbling. Lightning is said to have a great effect in causing it to bury itself.

Means of capture.—Most sought for during spring tides (except in the winter). "They are obtainable in sufficient quantities for bait all along the south coast as far as the Scilly Isles, by those who have used the seines made for their

capture, especially those of the Channel Island pattern, which have calico bunts or bags, by which the launce is kept swimming until they are dipped up and placed in the floating cases provided for keeping them alive" (W. Wilcocks).

"I was surprised to see the *Ammodytes* shovelled out from shelly and gravelly sand, to a depth of 2 feet, on the surface of which my weight hardly left a foot-mark" (Thompson). They are most readily captured during frosts. Sir T. Brown (1662) observed that smoulds were taken out of the sea-sands with forks and rakes, about Blakeney and Burnham: a small, round, slender fish about 3 or 4 inches long, as big as a small tobacco pipe: a very dainty dish.

Breeding.—Various accounts have been given at what period of the year this takes place, I have personally found at St. Ives examples of the small sand-eel with milt and roe very forward in the months of August and September. Thompson found some ready to deposit their spawn in Ireland at the end of July, but he remarks that in places they do so during the winter. Couch considered the end of December the most common period: so probably they continue spawning through the last few months of the year, dependant on the temperature, becoming very poor in winter after breeding. Their eggs are deposited in the loose sand.

Diseases, &c.—In July, 1881, the sea-shore between Burntisland and the East Neuk of Fife on the Fife side was literally strewn with dead sand-eels for several days. The cause was attributed to chemical agencies that flow directly into the Forth from the works along its margin.

Uses.—A capital bait, and much prized by sea-fowls. Couch remarks that he had been informed that if mackerel are found to be after this species of launce a more successful fishing is anticipated than if they are pursuing the larger sand-eels. It is said by Lloyd to be most difficult to keep alive in an aquarium. One summer at Hamburg he received twenty brought alive during a ten hours' voyage in a 10 gallon vessel of water. The creatures took an impetuous rush and a wriggle through the tank and turned up dead, some almost instantly and some a little later, with the exception of one which lived thirty-six hours. Subsequently he saw two living examples in a tank about 4 feet long and 18 inches deep, containing about 4 inches of sand at the bottom, but no other occupants, and the whole kept in a cellar.

As food.—Excellent eating, especially while in roe, but in winter after spawning it becomes thin.

Habitat.—Northern shores of Europe and occasionally a few may stray into the Mediterranean.

Orkneys in vast quantities (Low), and common in Zetland (W. Baikie): Edward recorded taking his first six examples from four to five inches in length at Banff in March 1863; since then he has captured several, but always during the winter months, save one in the summer (Zool. p. 8495): Aberdeen (Sim): abundant, and used as bait in the Moray Firth: St. Andrew's occasional (McIntosh): Firth of Forth plentiful during the summer months, especially on the sands above Queensferry, where the large sand-eel is never found. At Musselburgh and Portobello the two species inhabit the same locality (Parnell). Yorkshire resident and abundant (Yorkshire Vertebrata): Norfolk Estuary (Lowe), in short, very common along the shores of Scotland and the E., W., and S. coasts of England. On the S. coast of Devon it is common and used as food from May until October (Parfitt): abundant off some sandy bays in Cornwall, especially St. Ives: Guernsey. I have taken it at Weston-super-Mare in Somersetshire.

In Ireland common round the coast.

The example figured life size was a male. The largest I have taken has been 7 inches in length.

3. **Ammodytes cicerellus**, Plate XCII, fig. 3.

Cicerellus messaniensis, P. Boccone, Research. et obs. Nat. 1674, p. 294, c. fig. p 287.

Ammodytes cicerellus, Rafin. Caratt. p. 21, sp. 52, pl. ix, f. 4; Kröyer, Dan. Fiske, iii, p. 589; Moreau, Poiss. France, iii, p. 219.

Ammodytes tobianus, Risso, Ich. Nice, p. 95; Costa, Fauna Nap. pl. li; Canestr. Fauna Ital. p. 191.

Ammodytes argenteus, Risso, Hist. Nat. Eur. iii, p. 209.

Ammodytes siculus, Swainson, Zool. Illus. 2nd series, i, pl. lxiii, f. 1, and Fish. ii, p. 254; Günther, Catal. iv, p. 386, and Ann. and Mag. Nat. History, 1867 (5) xx, p. 290; Steind. Ich. Span. u. Port. 1869, p. 46, pl. ii, f. 3; Giglioli, Pesc. Ital. p. 37.

B. vii, D. 53-59, P. 14, A. 28-30, C. 19.

Length of head $4\frac{2}{3}$ to $5\frac{3}{4}$, of caudal fin 11 to $11\frac{1}{2}$, height of body $11\frac{1}{2}$ to 15 in the total length. *Eye*—diameters $5\frac{1}{2}$ to $6\frac{1}{2}$ in the length of the head, $1\frac{1}{2}$ diameters from the end of the snout, and 1 apart. Lower jaw projecting a little distance beyond the upper: premaxillaries protractile: the posterior extremity of the upper jaw reaches to almost or quite beneath the front edge of the orbit. *Teeth*—absent and vomer unarmed. *Fins*—the dorsal commences a short distance behind the end of the pectoral fin, its upper border is not straight, the first few rays being more elevated than the succeeding ones, while another elevation occurs at the middle of the fin, and a third near its extremity: the anal is similarly elevated near its termination: caudal forked. *Scales*—the body is smooth, but a few deciduous scales are usually found on its posterior part. *Colours*—back olive, with a brilliant silvery band passing along the side from the head to the base of the caudal fin; often a blue spot on the top of the head, which is tinged with bronze and gold.

Names.—Smooth sand-launce.

As food.—Said to be very delicate eating.

Habits.—Arrives off Nice in May and June, and is most common during the spring-time, while in Italy it is most in season from February until April.

Habitat.—Dr. Günther observes that the example in the British Museum, 6 inches in length, was dredged at sea off Shetland in 80 or 90 fathoms; if such is the case, this species must be admitted to our fauna. Normally it appears to be a resident in the Mediterranean, especially in its eastern portion, and off Sicily and Naples.

The example is figured life size.

Family, III—MACRURIDÆ, *Richardson.*

Branchiostegals six or seven: pseudobranchiæ absent. Body somewhat enlarged anteriorly, and continued into a long, compressed, and tapering tail. Two dorsal fins, the first composed of a few rays, the anterior of which may be spinate: the second consisting of weak rays, being long, low, and continued to the end of the tail: anal similar in extent to the second dorsal: caudal absent. Ventral jugular or thoracic. Pectoral present. Scales ridged, keeled or spined. Pyloric appendages numerous.

Cosmopolitan deep sea forms, which have been most frequently captured at depths varying from 120 to upwards of 2500 fathoms.

Genus I—Coryphænoides, *Günner.*

Branchiostegals six or seven: pseudobranchiæ absent. Body elongated, tapering from behind the head into a compressed and fine tail. No prominent ridges on the head: snout obtuse and obliquely truncated: no bony articulation between the angle of the preopercle and the suborbital ring of bones: an indistinct ridge on the angle of the preopercle. Teeth in jaws villiform, an enlarged outer row in the upper jaw: none on the vomer or palatines. A barbel present. A single short anterior dorsal fin, armed with a serrated spine: second dorsal low and long extending to the caudal and composed of weak rays: anal of somewhat similar extent. Ventral below or in front of the insertion of the pectoral. Scales of moderate size or small, and either smooth or spiny. Air-bladder present. Pyloric appendages numerous.

1. Coryphænoides rupestris, Plate XCIII.

Berg-lax, Ström, Sond. i, p. 267.

Coryphænoides rupestris, Günner, Trondhj. Selsk. Skrift. iii, p. 50, t. iii, f. 1.

Lepidoleprus norvegicus, Nilss. Prod. p. 51.

Macrourus stroemii, Reinh. Dansk. Vid. Selsk. Afhand. vii, p. 129; Sundev. Vet. Akad. Handl. 1840, p. 1; Gaimard, Voy. Scand. Poiss. pl. xi.

Macrourus norvegicus, Nilss. Skand. Faun. Fisk. p. 600.

Coryphænoides norvegicus, Günther, Catal. iv, p. 396, Annals and Mag. (4) 1874, xiii, p. 139.

Coryphænoides rupestris, Collett, Norges Fiske, p. 131; Winther, Ich. Dan. Mar. p. 36.

B. vii, D. $\frac{1}{10}$/190, P. 18-19, V. 8, A. 190.

Length of head $4\frac{1}{4}$ to $4\frac{1}{2}$, height of body $5\frac{1}{2}$ in the total length. *Eye*—diameter 1/4 of the length of the head, $1\frac{1}{4}$ diameters from the end of the snout, and $1\frac{1}{4}$ apart. Interorbital space concave. The height of the head equals its length excluding the snout: while the width of the head equals its postorbital length. Snout obtuse and obliquely truncated. Cleft of mouth lateral, the posterior extremity of the maxilla reaching to nearly or quite beneath the front edge of the orbit. A very short barbel beneath the chin. Posterior edge of preopercle crenulated: no bony connection between it and the suborbital ring of bones. *Teeth*—in the jaws small, with the outer row very slightly the larger: none on the palate. *Fins*—the first dorsal commences over the middle of the opercle, its first ray strong, compressed, spinate, and having its anterior edge furnished with serrations directed upwards. The second dorsal commences a short distance posterior to the first dorsal, is very low at first, but gradually increases a little in

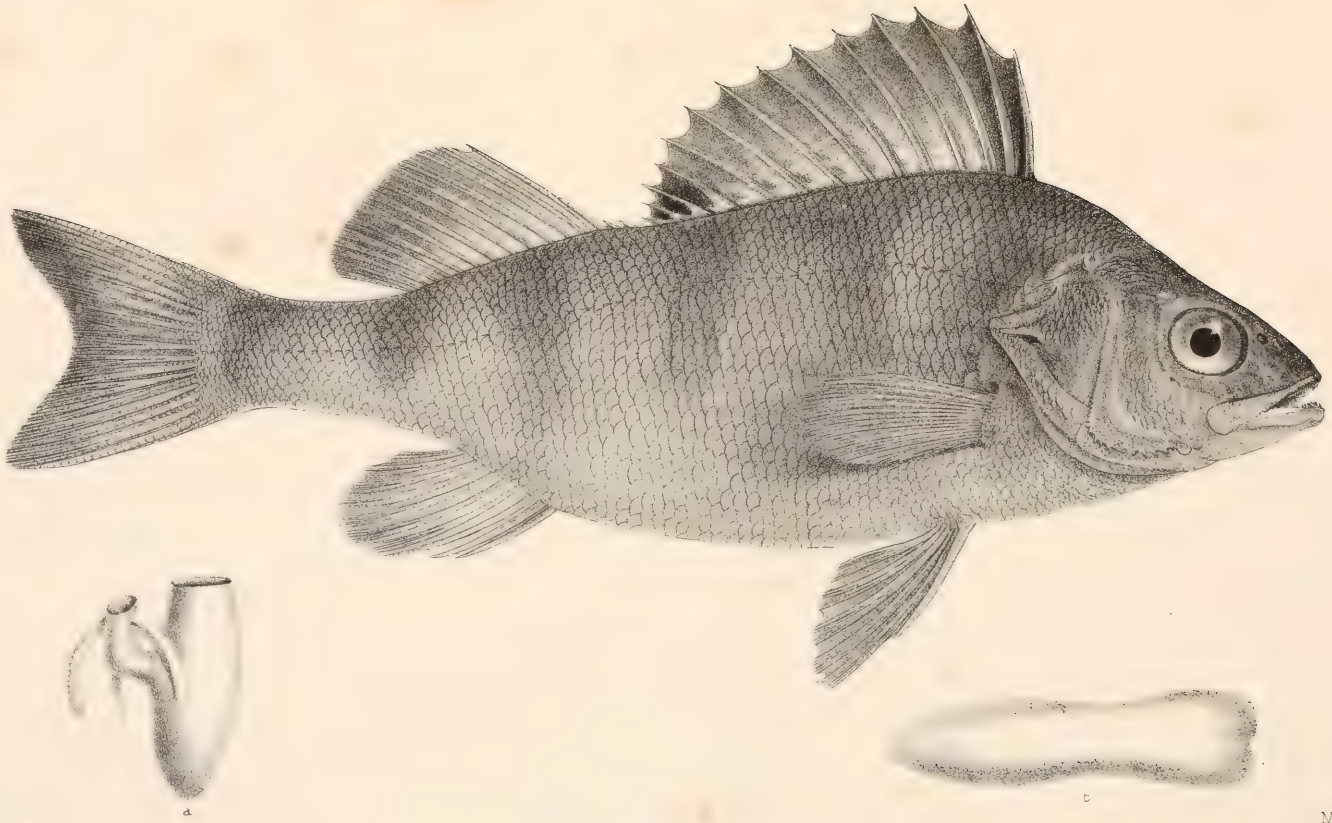
height and is continued to the end of the tail. Pectoral as long as the head excluding the snout. Ventral situated on the throat anterior to the insertion of the pectoral. Anal commences beneath the first third of the pectoral, its rays are longest anteriorly, considerably exceeding those of the second dorsal, and are continued to the end of the tail. No caudal fin. *Scales*—eight or nine rows between the lateral-line and the base of the first dorsal fin. The scales are armed with several horizontal and parallel raised lines, ending in spines at the posterior edge of the scale, while in the anterior half of the body they have hairy-like projections. There are 60 longitudinal rows along the upper edge, and 65 along the lower edge of the lateral-line. Vent situated on a vertical line below the last ray of the first dorsal fin. *Colour*—silvery apparently without any markings.

Habits.—Of these almost nothing is known, the species residing at considerable depths in the ocean.

Habitat.—From the coasts of northern and western Norway and Denmark to the Faroës and Shetland Isles. The example figured life size, and which is nearly 6 inches in length, was dredged by the "Porcupine" at 500 fathoms depth. A smaller one was taken at 200 fathoms, they came from off the Shetland and Faroës. It attains to at least 10 inches in length.

END OF VOLUME I.

LONDON: G. NORMAN AND SON, PRINTERS, HART STREET, COVENT GARDEN.

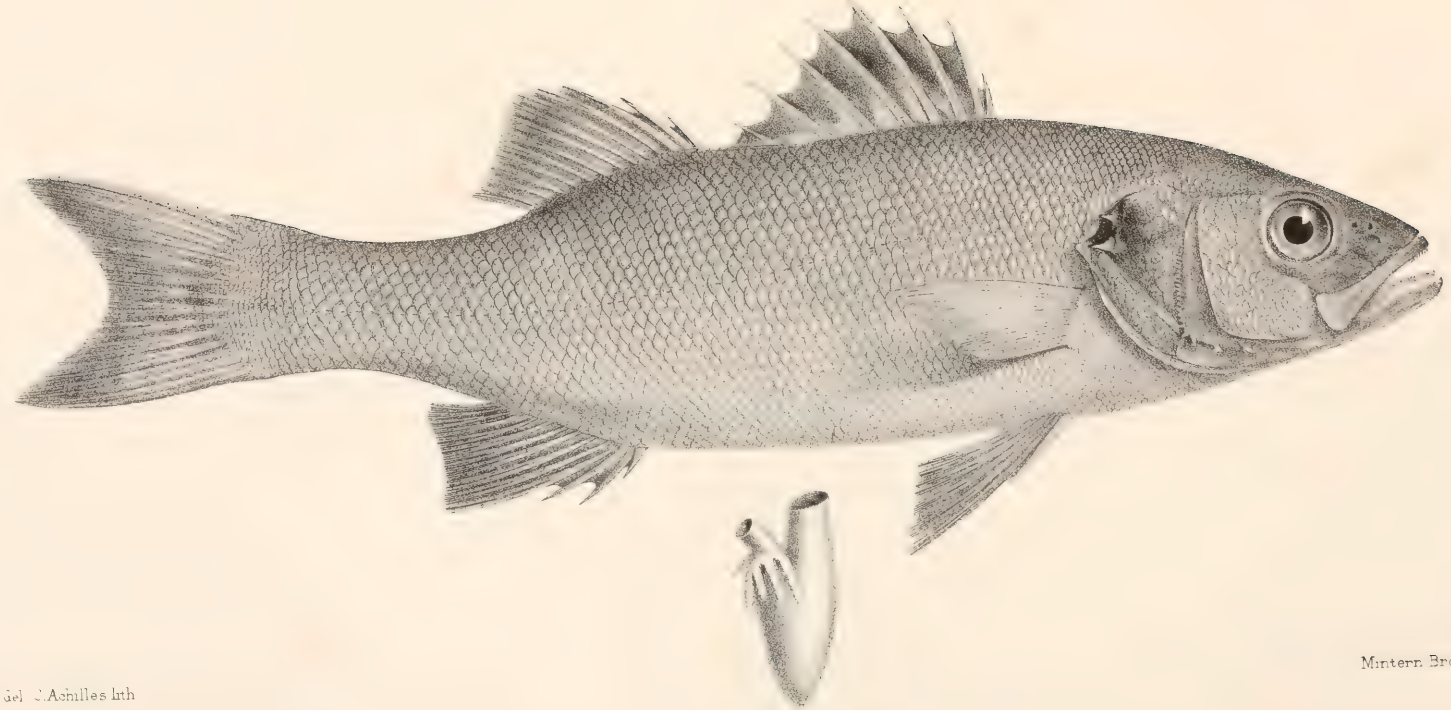


F Day del C Achilles lith

Muntern Bros imp

PERCA FLUVIATILIS

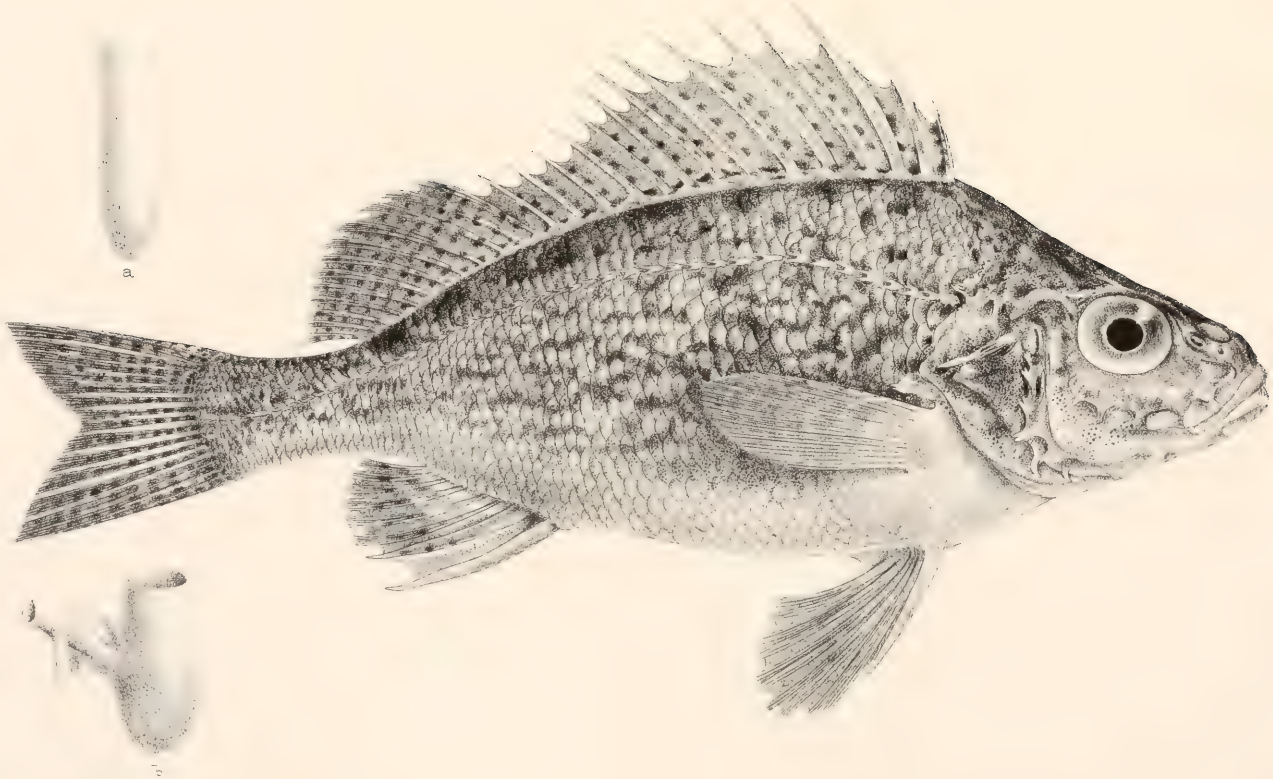
a Stomach and pyloric appendages b Air bladder



F. Day del. J. Achilles lith.

Mintern Bros. imp.

LABRAX LUPUS

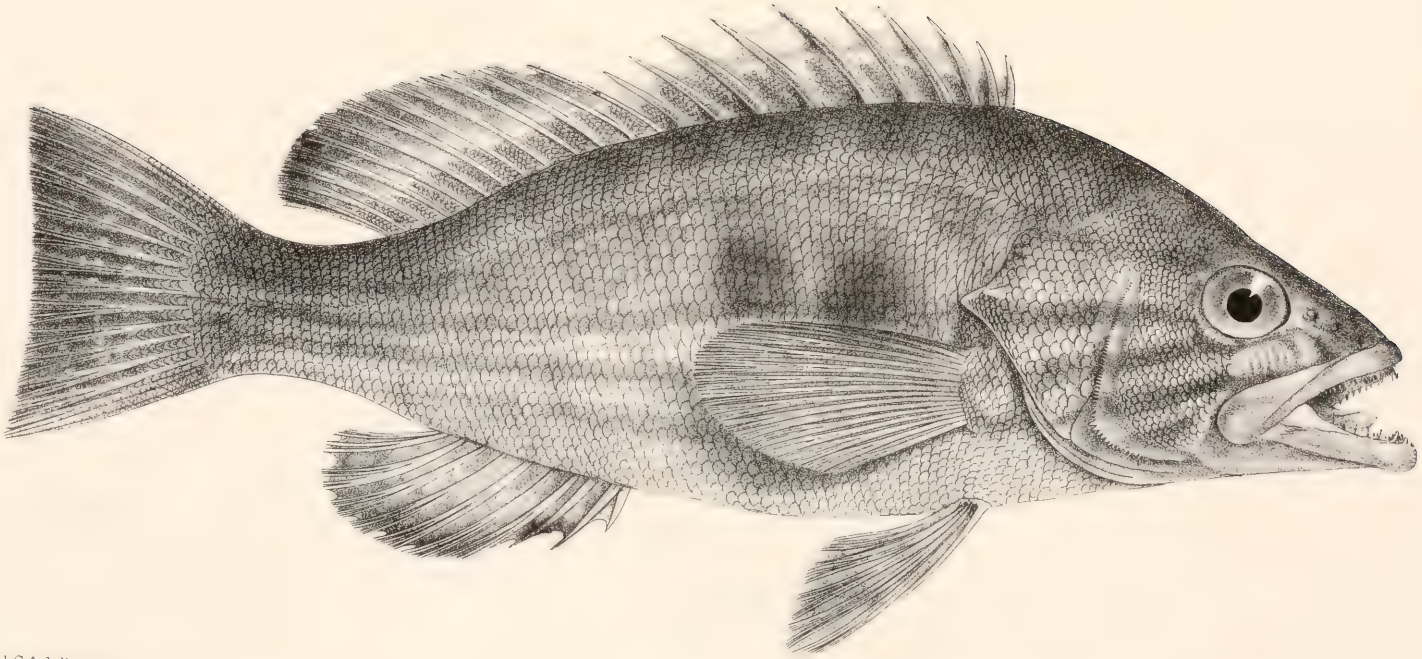


F. Day del. C. Achilles sc.

Museum Press imp.

ACERINA VULGARIS.

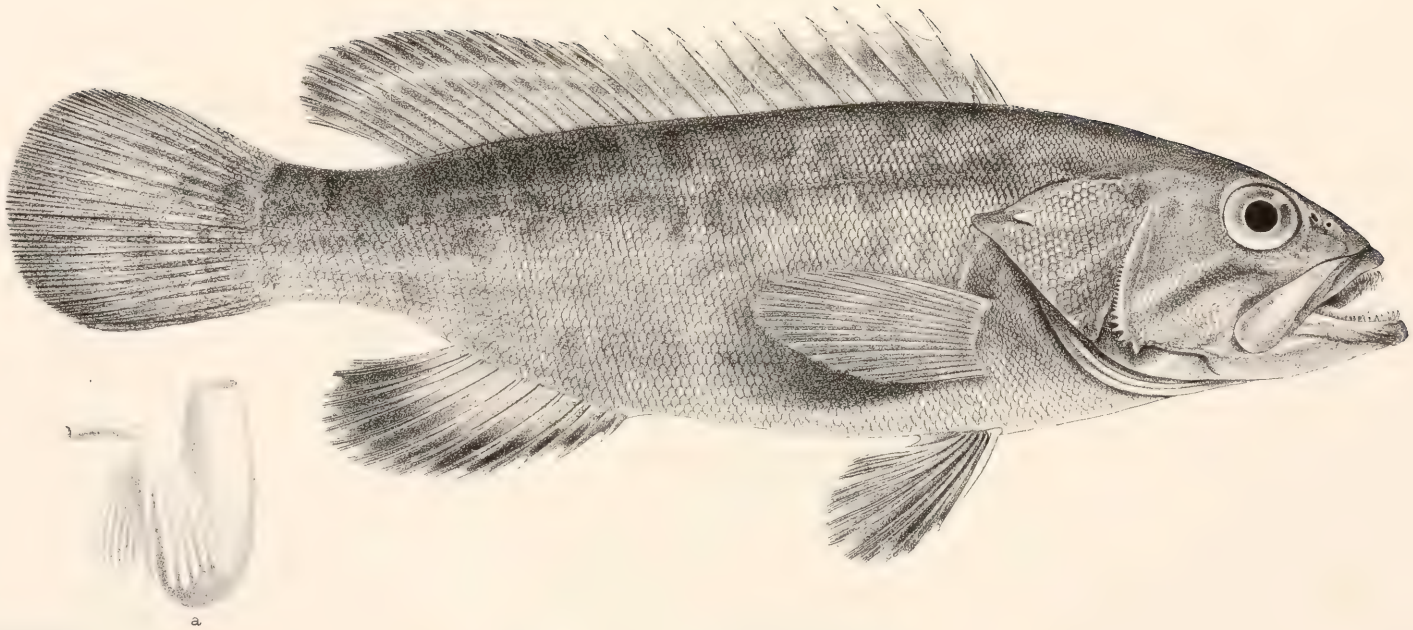
a. Air-bladder. b. Stomach and pyloric appendages.



F Day del C Achilles lith

Mintern Bros imp

SERRANUS CABRILLA

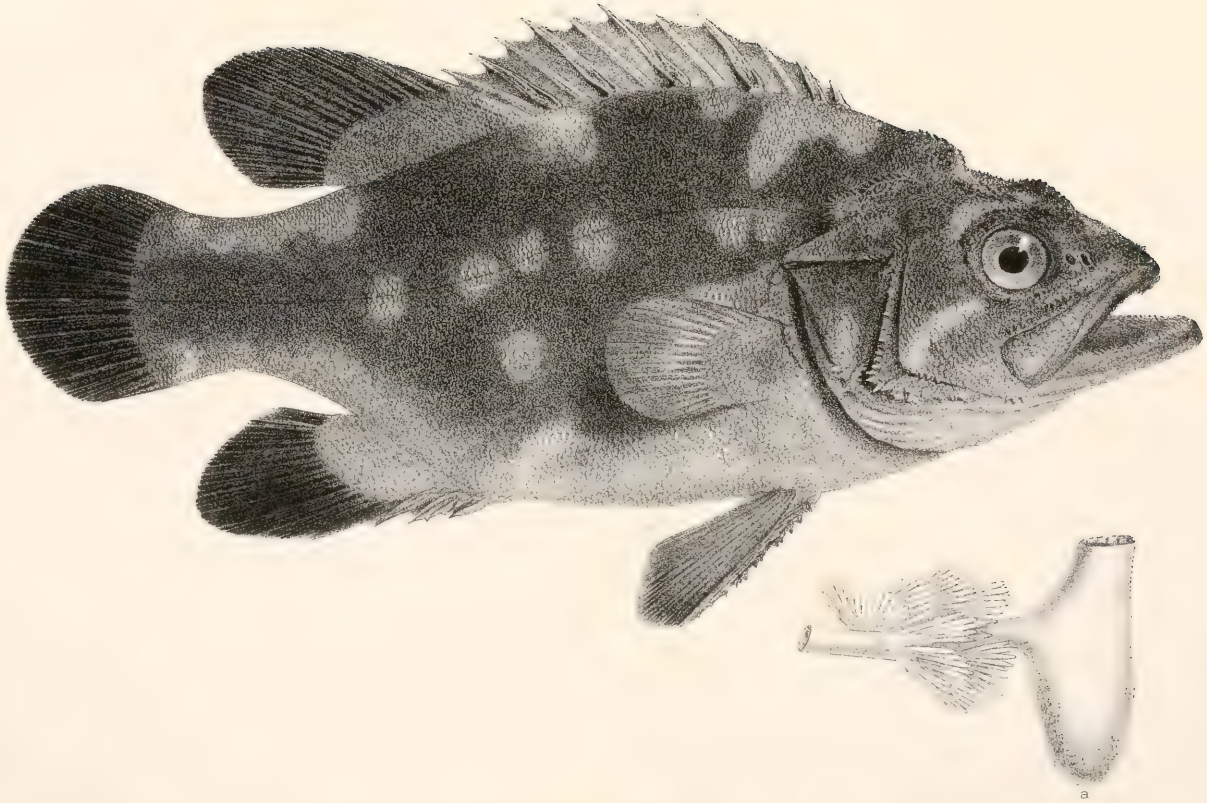


F. Gray del C. Achille, lith

Mintern Bros imp

SERRANUS GIGAS

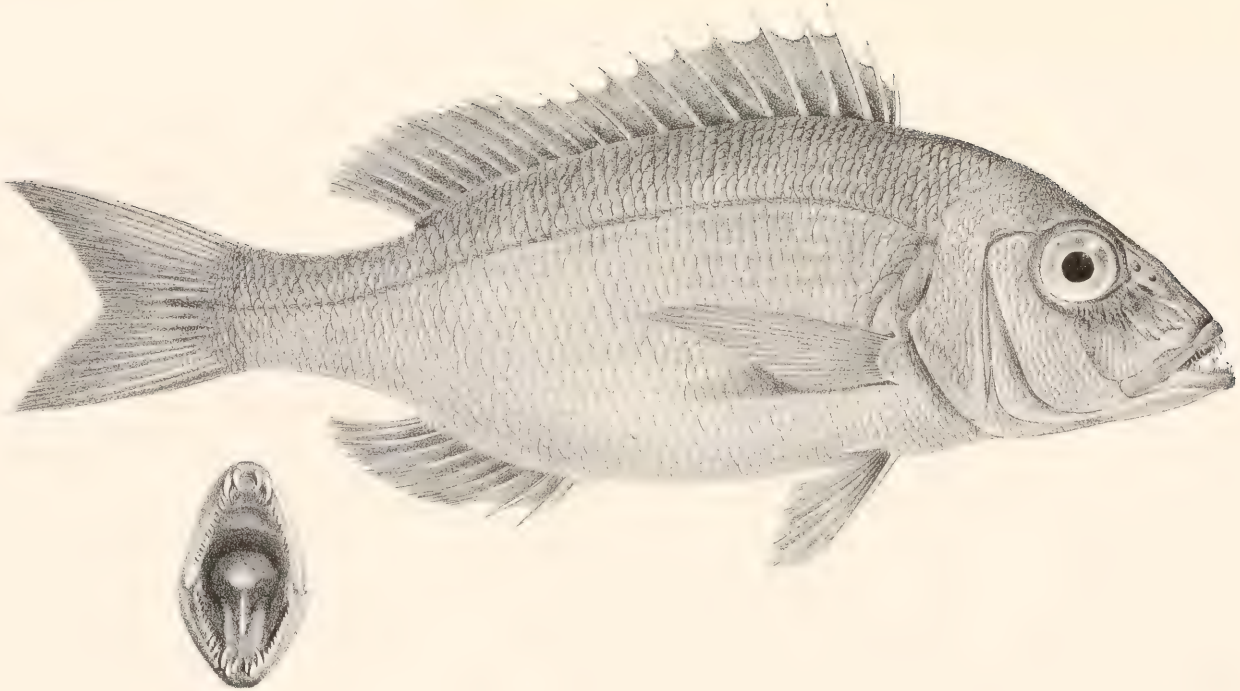
a Stomach and pyloric appendages



Mintern Bros. imp.

POLYPRION CERNIUM

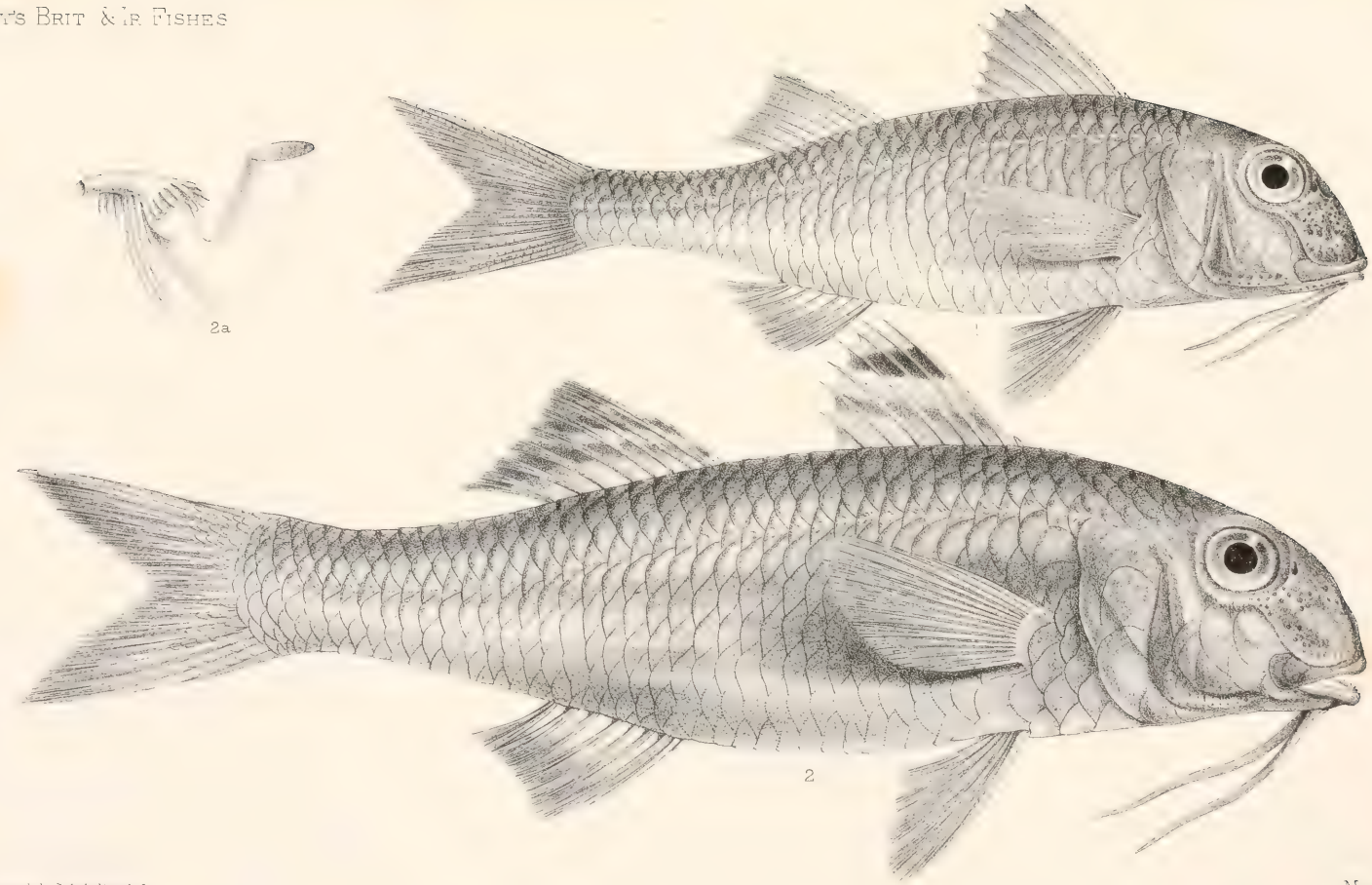
a Stomach and pyloric appendages



F Day del C Achilles lith

Mintern Bros imp

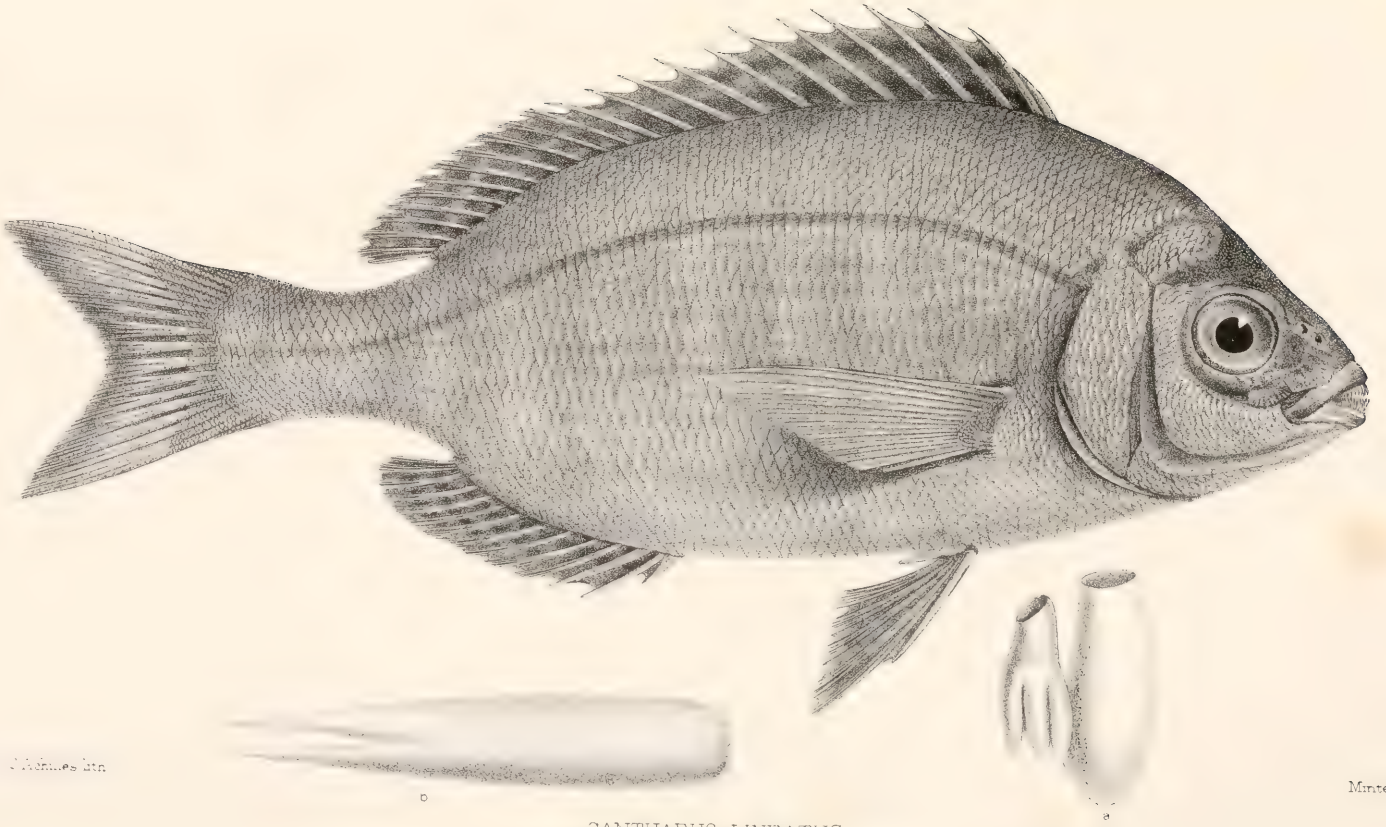
DENTEX VULGARIS



F. Day del. C. Achilles lith

Mintern Bros imp

1. MULLUS BARBATUS 2 VARIETY MULLUS SURMULETUS
2a Stomach and pyloric appendages

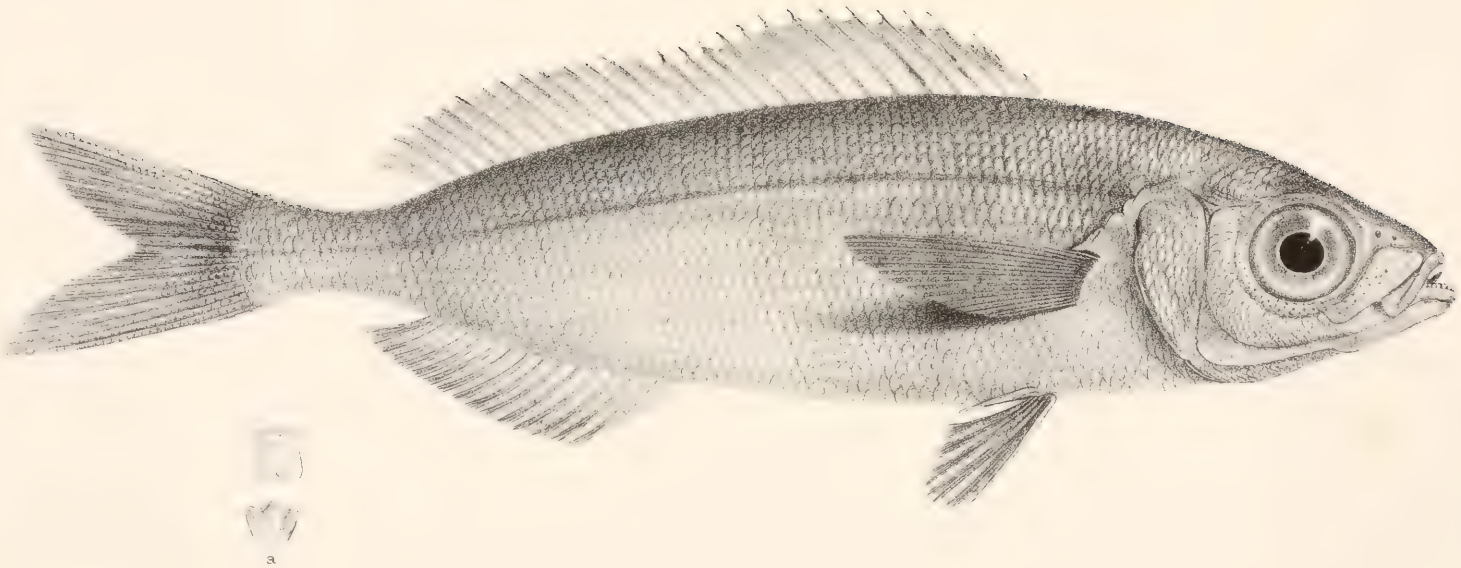


Day & Hughes lith

Mintern Bros imp

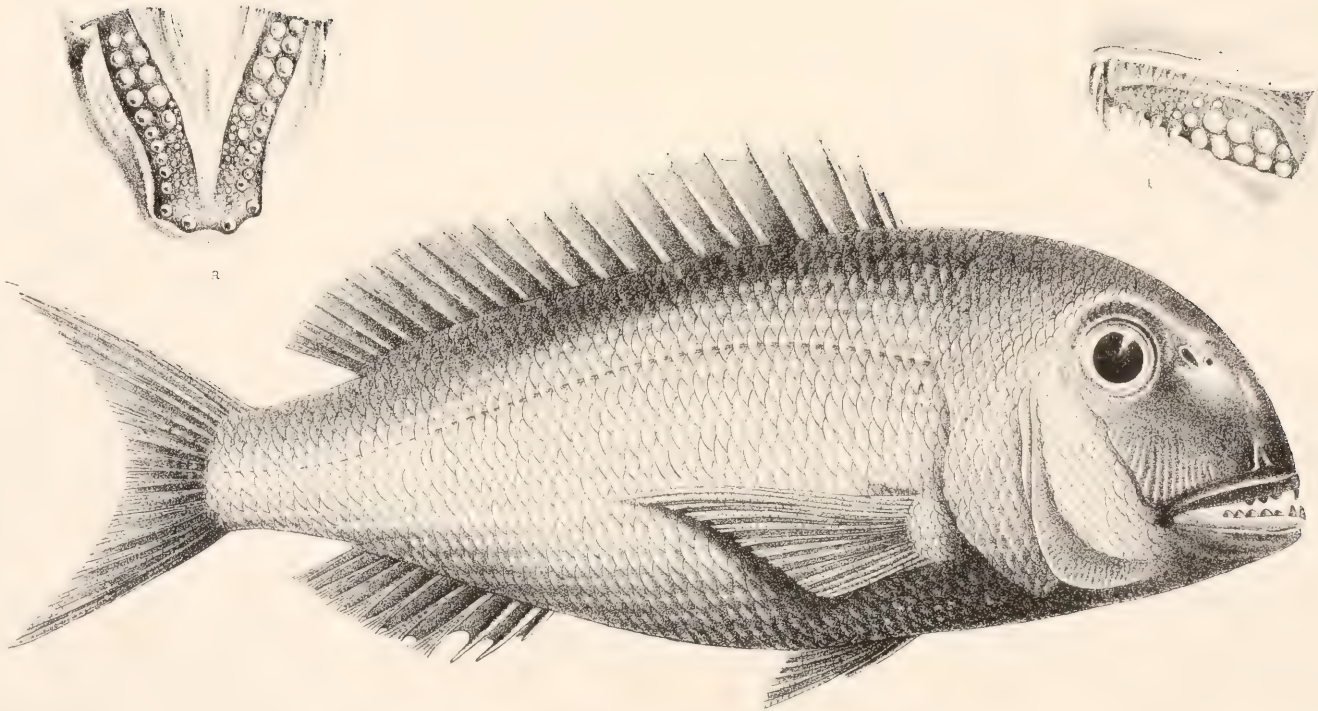
CANTHARUS LINEATUS

a Stomach and pyloric appendages b Air-bladder

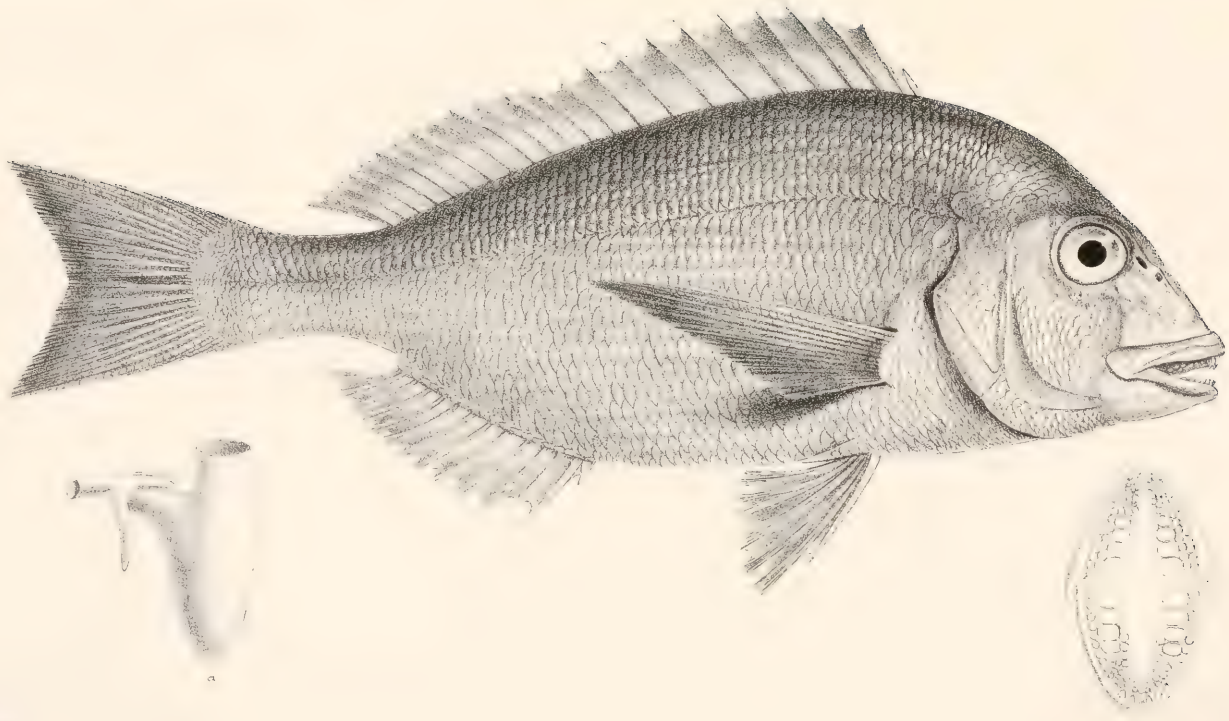


F Day del C Achilles lith

BOX VULGARIS
a Teeth



PAGRUS VULGARIS
Upper jaw — b Lower jaw

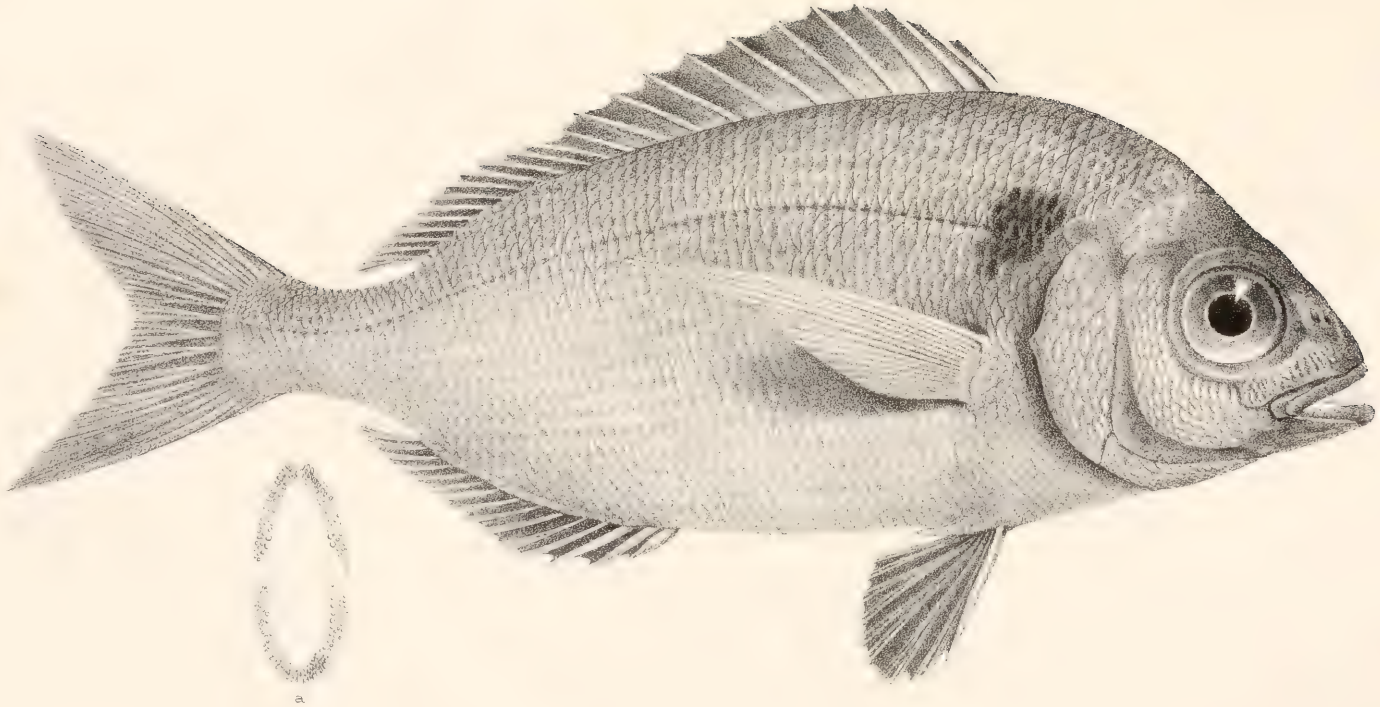


F Day del C Achilles lith

Mintern Bros imp

PAGRUS AURATUS.

a Stomach and pyloric appendages b Dentition



F. Day del. C. Achilles lith.

Malcolm Sims imp.

PAGELLUS CENTRODONTUS.

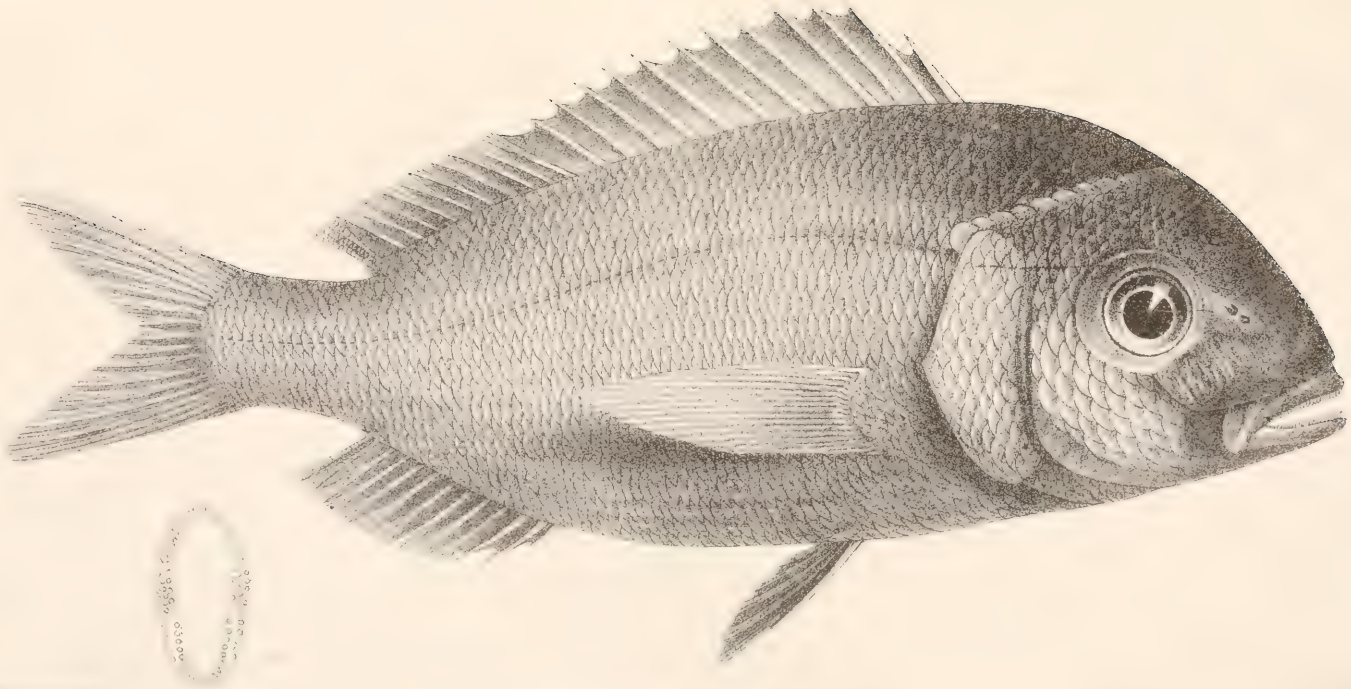
a. Dentition.

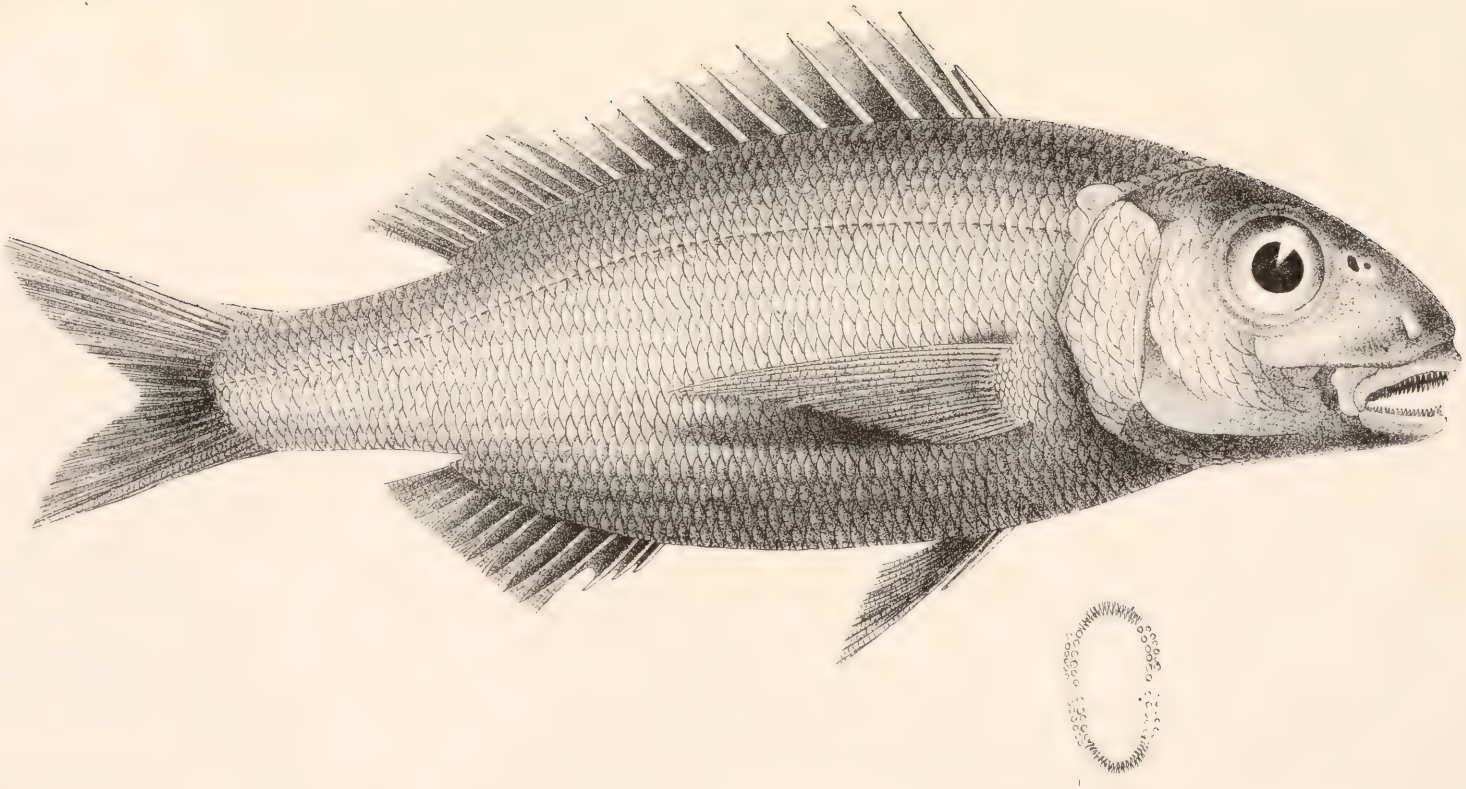
F Fay del C Achilles lith

Mintern Bros imp

PAGELLUS BOGARAVEO

a Stomach and pyloric appendages b Dentition

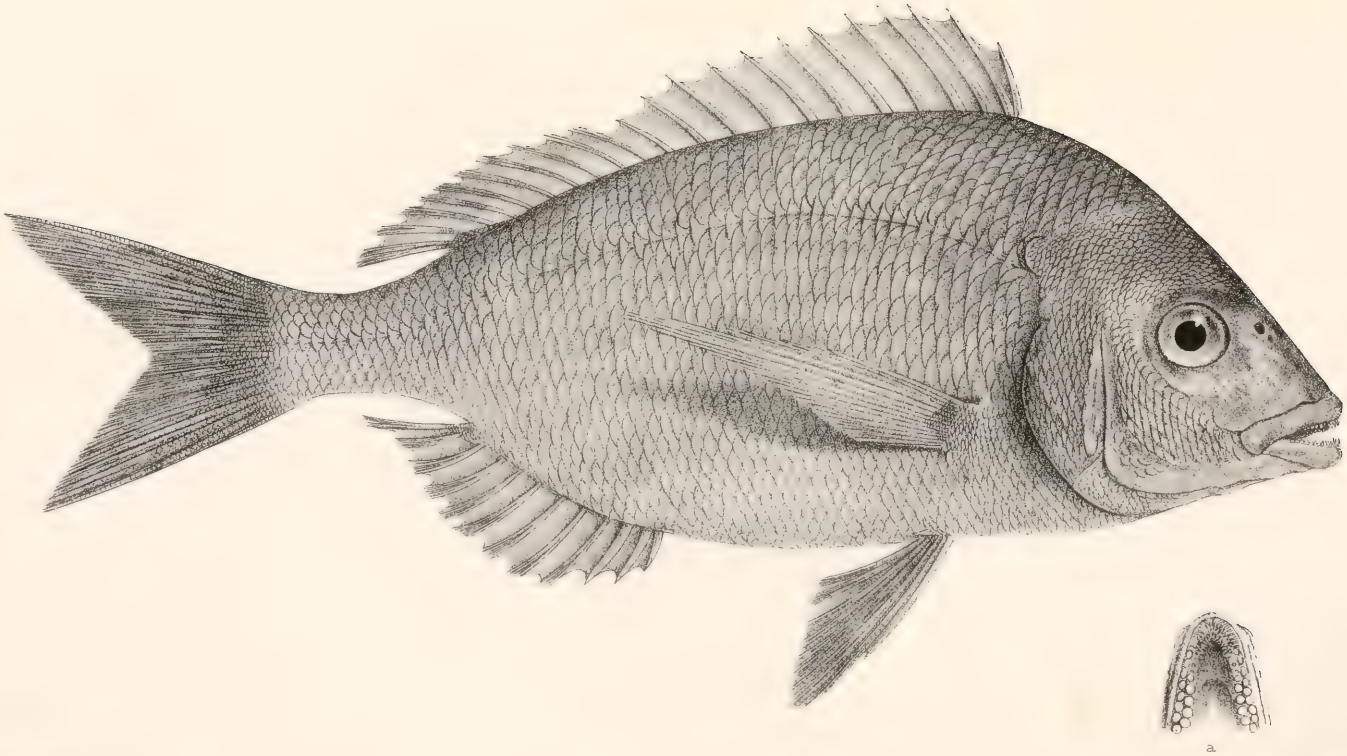




J. Day del. A. Hammond lith.

Hanhart imp.

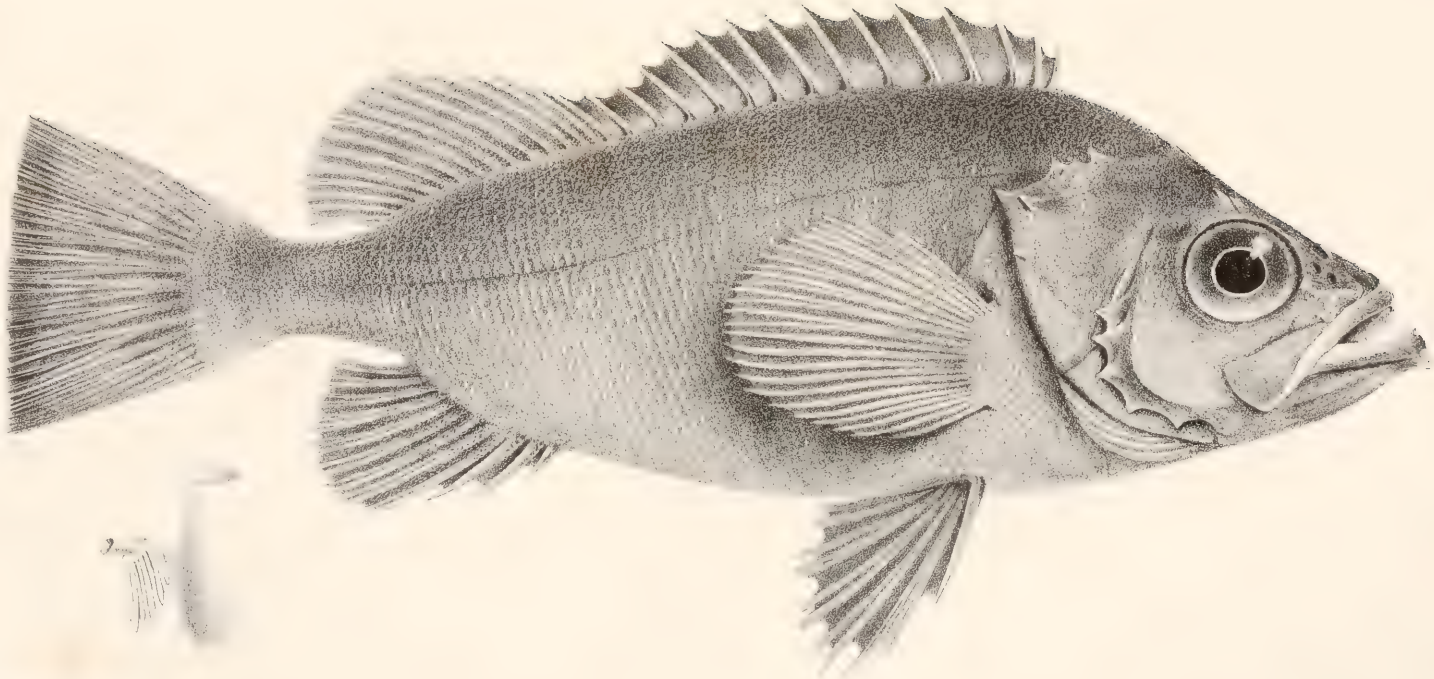
PAGELLUS ACARNE.
a Dentition



F Day del. C Achilles lith

Mintern Bros imp

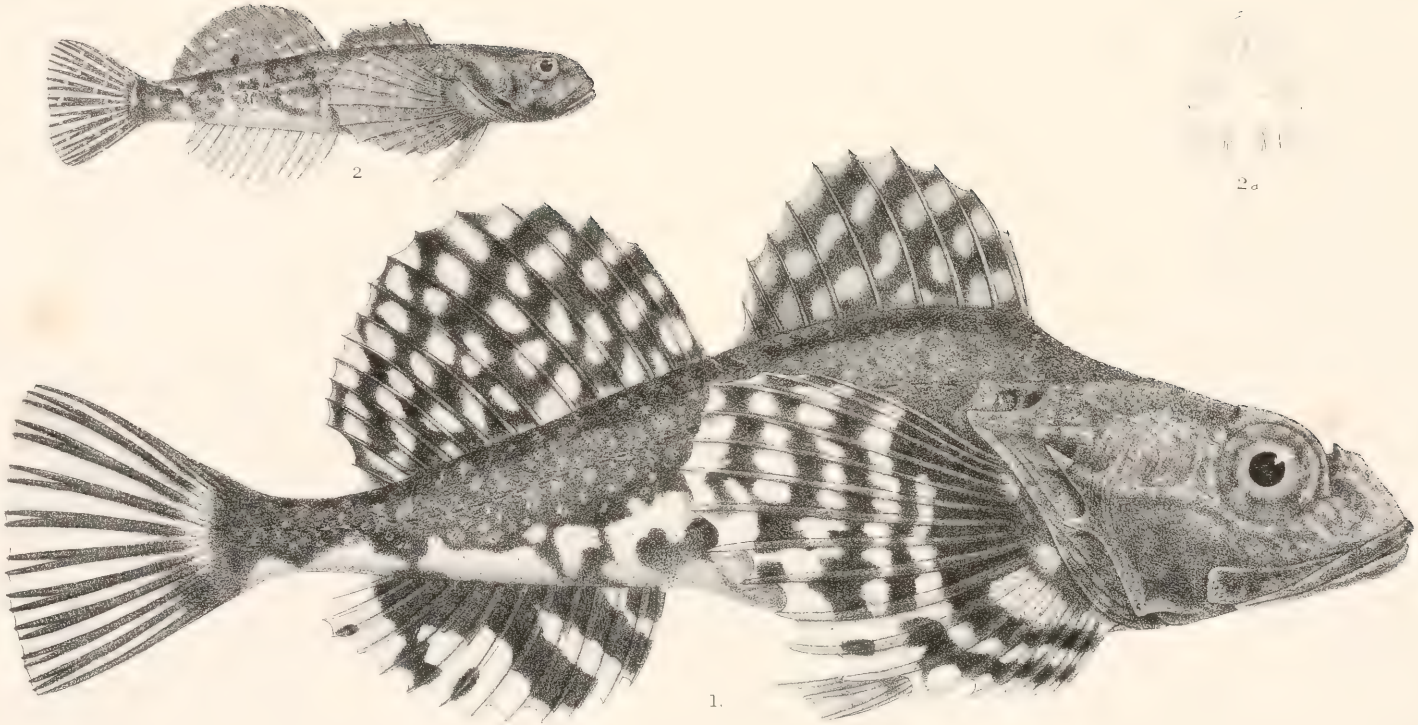
PAGELLUS ERYTHRINUS
a Lower jaw with teeth



J. Hay del. C. Achilles lith.

Mintern Bros. imp.

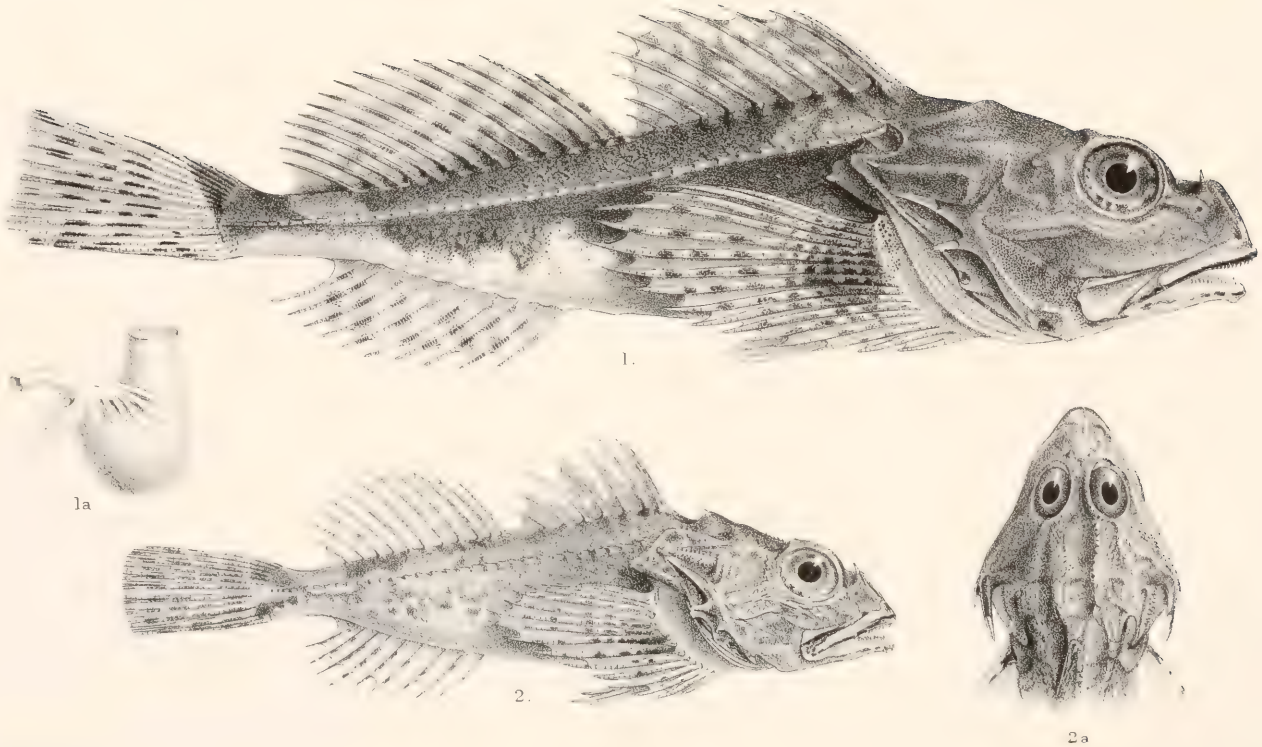
SEBASTES NORWEGICUS



F Day del C Achilles lith

Mintern Bros imp

1 COTTUS SCORPIUS (VARIETY GROENLANDICUS)
2 COTTUS GOBIO 2a under surface of head



F. Day del. C. Achilles lith.

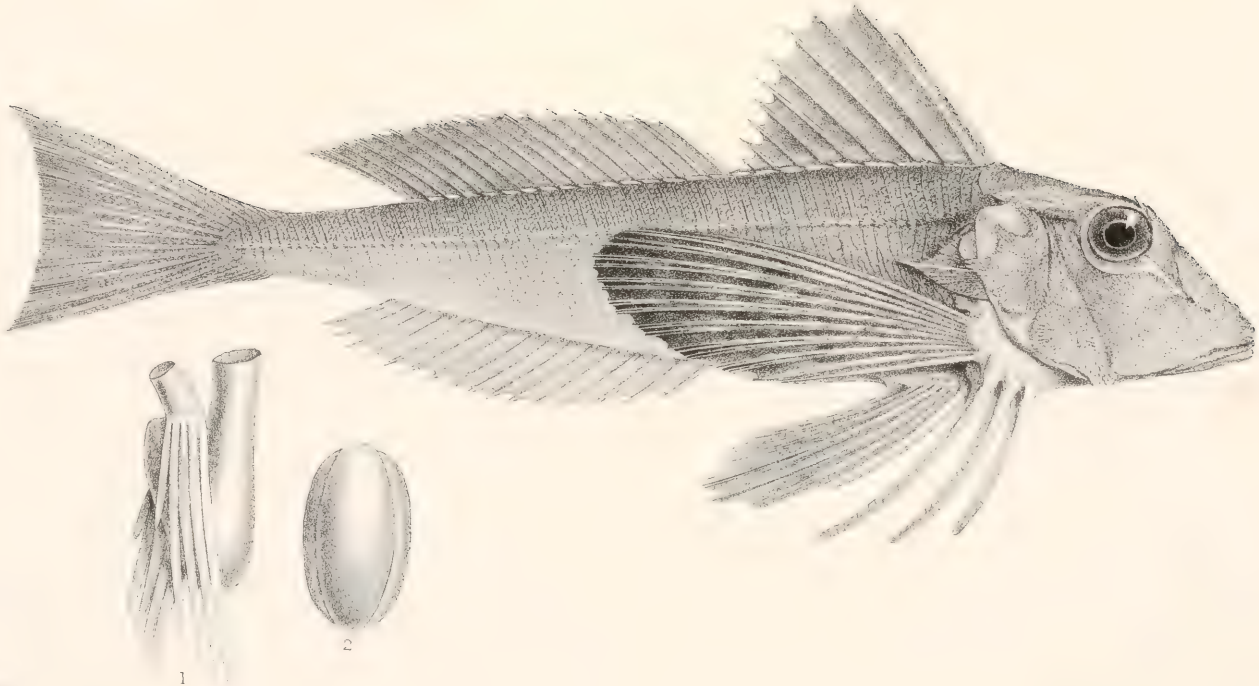
Mintern Bros. imp.

1. COTTUS SCORPIUS. 2. C. BUBALIS.

F. Day del. C. Achilles lith.

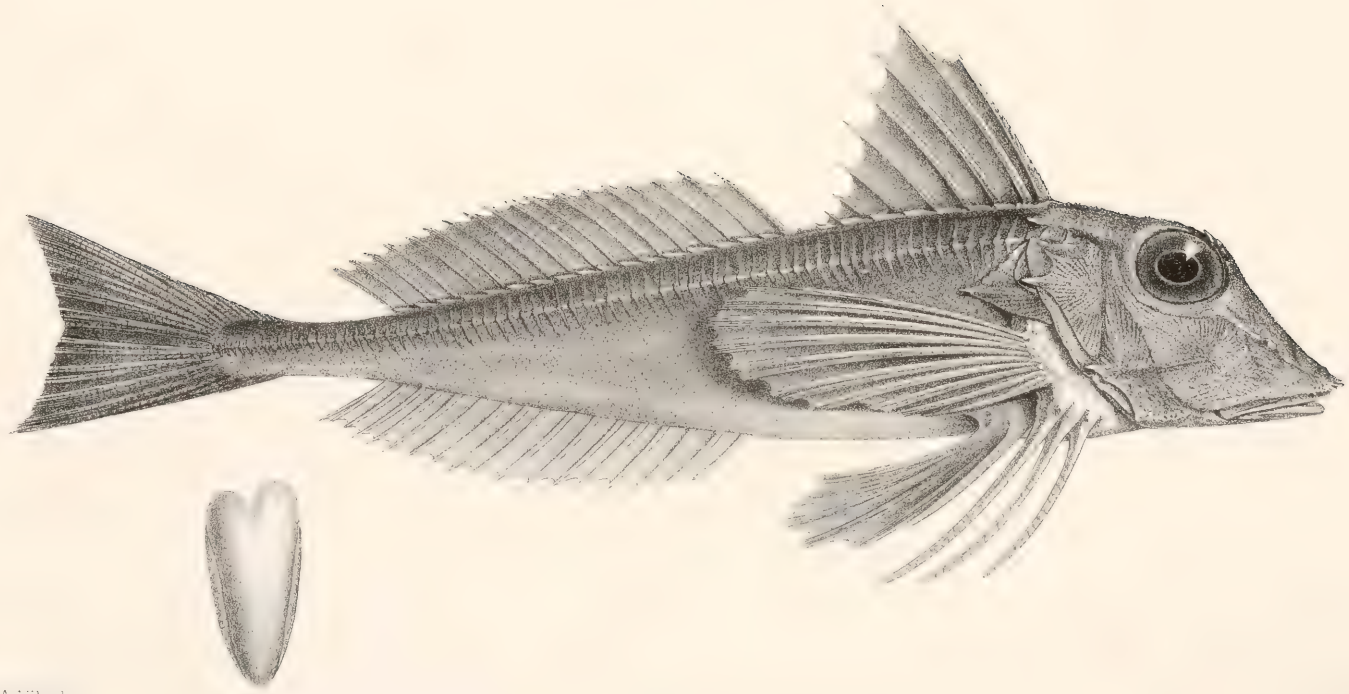
Mintern Bros. imp.

COTTUS QUADRICORNIS.



TRIGLA LINEATA.

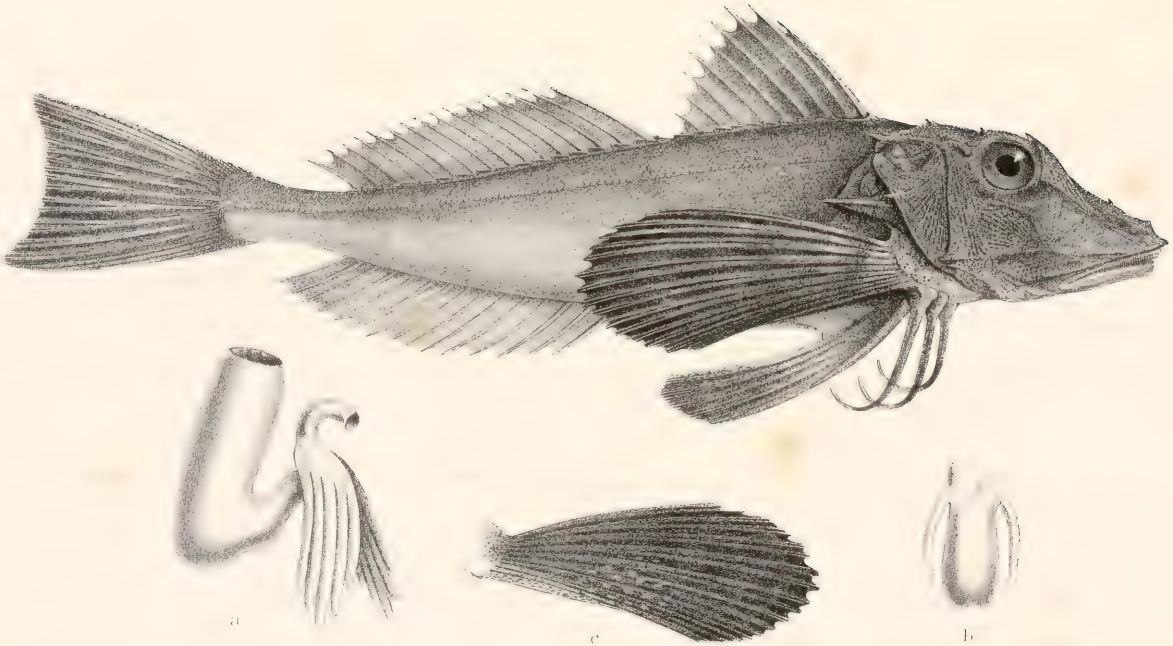
1. Stomach and pyloric appendages. 2. Air bladder.



F Lay del C Achilles lith

Mintern Bros imp

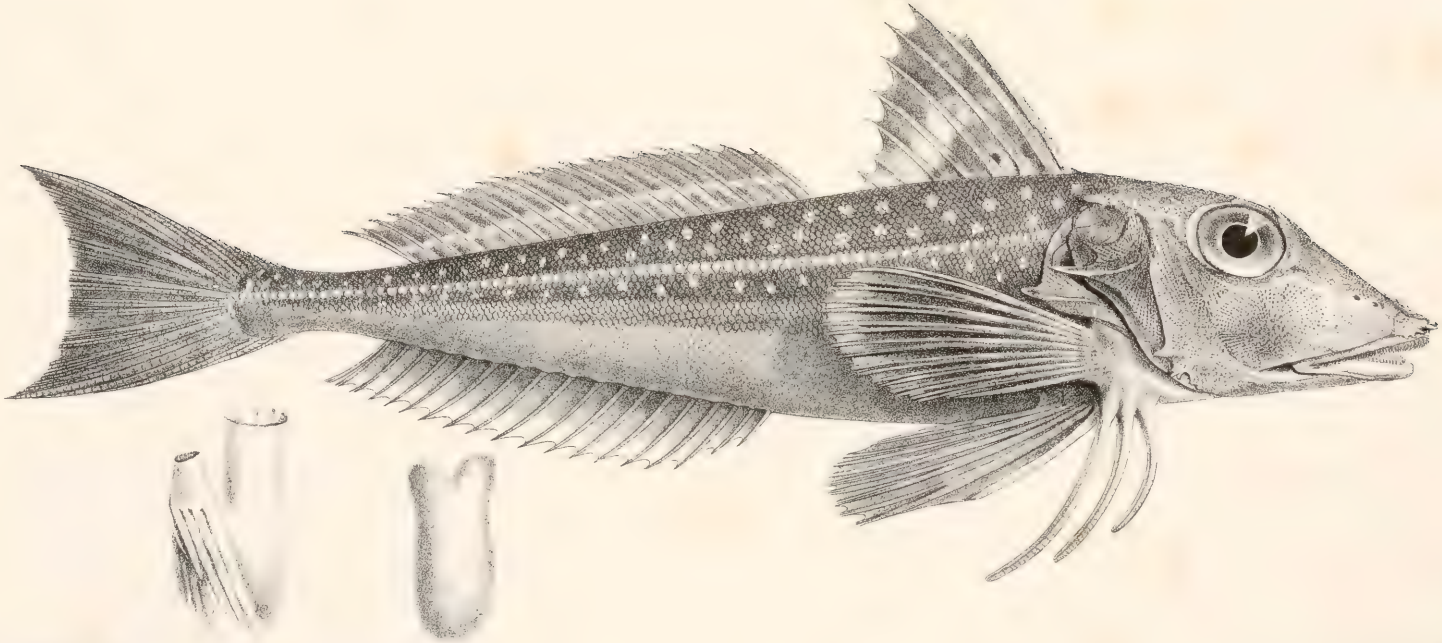
TRIGLA CUCULUS
1 Air-bladder



F Day del C Achilles lith Mintern Bros imp

TRIGLA HIRUNDO

a Stomach b Air-bladder c Pectoral fin (inner side)

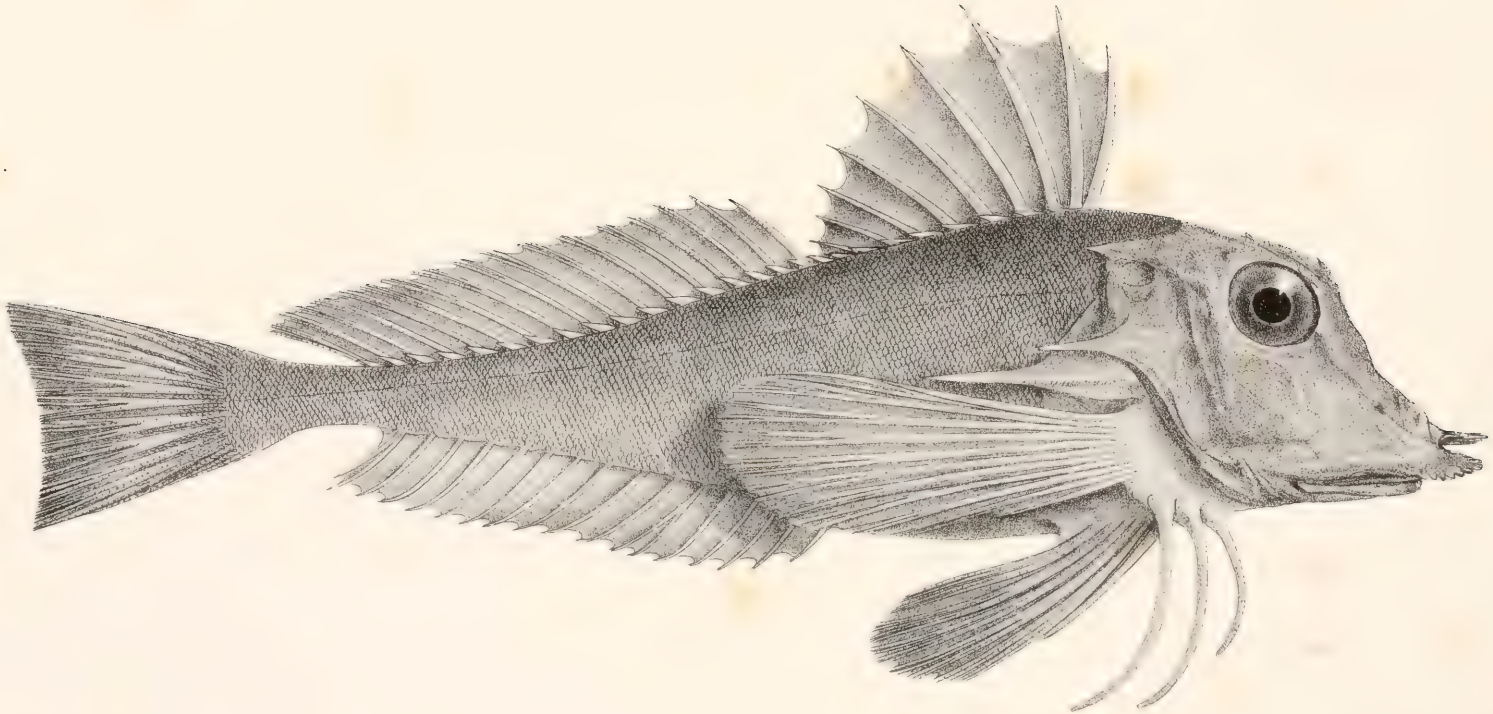


F. Lay del. C. Achilles lith.

Mintern Bros. imp.

TRIGLA GURNARDUS

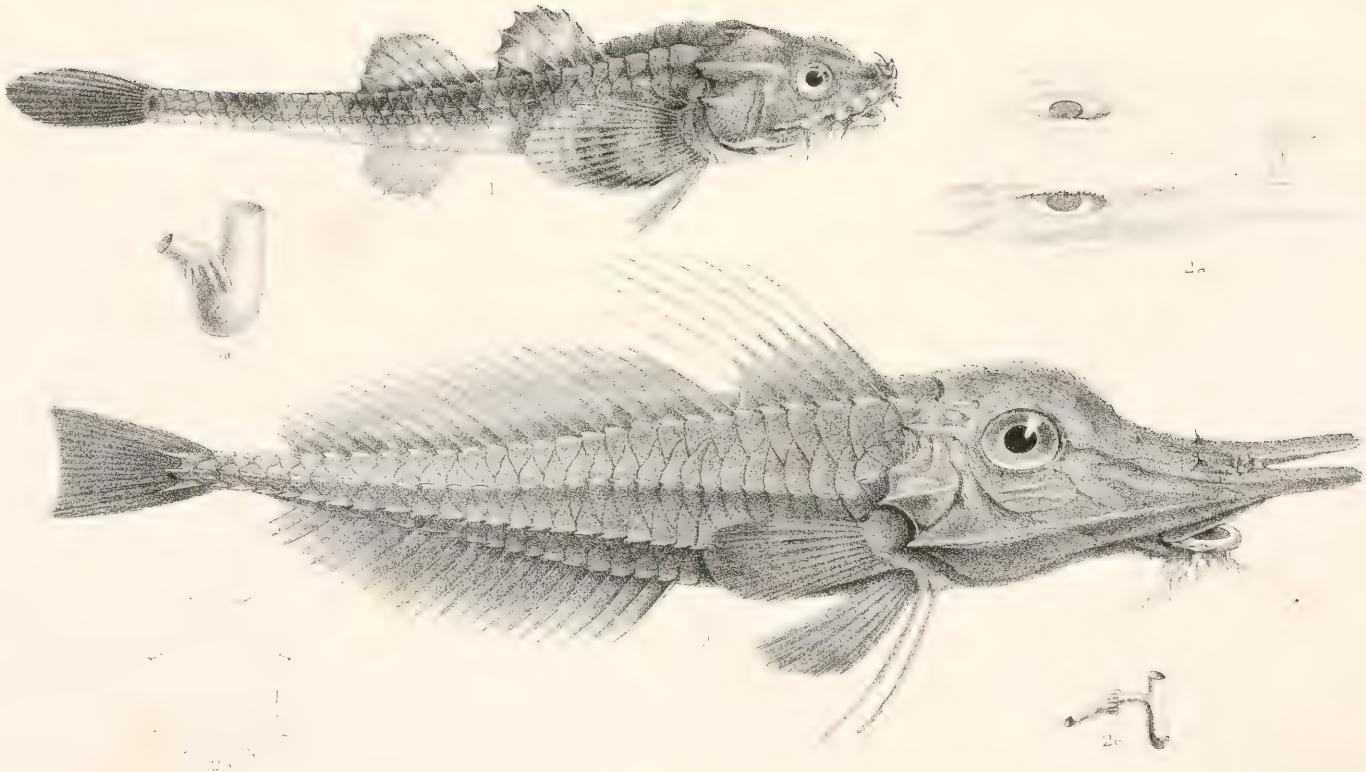
1. Stomach and pyloric appendages. 2. Air bladder.



F. Day del. C. Achates lith. Mintern Bros. imp.

TRIGLA LYRA.

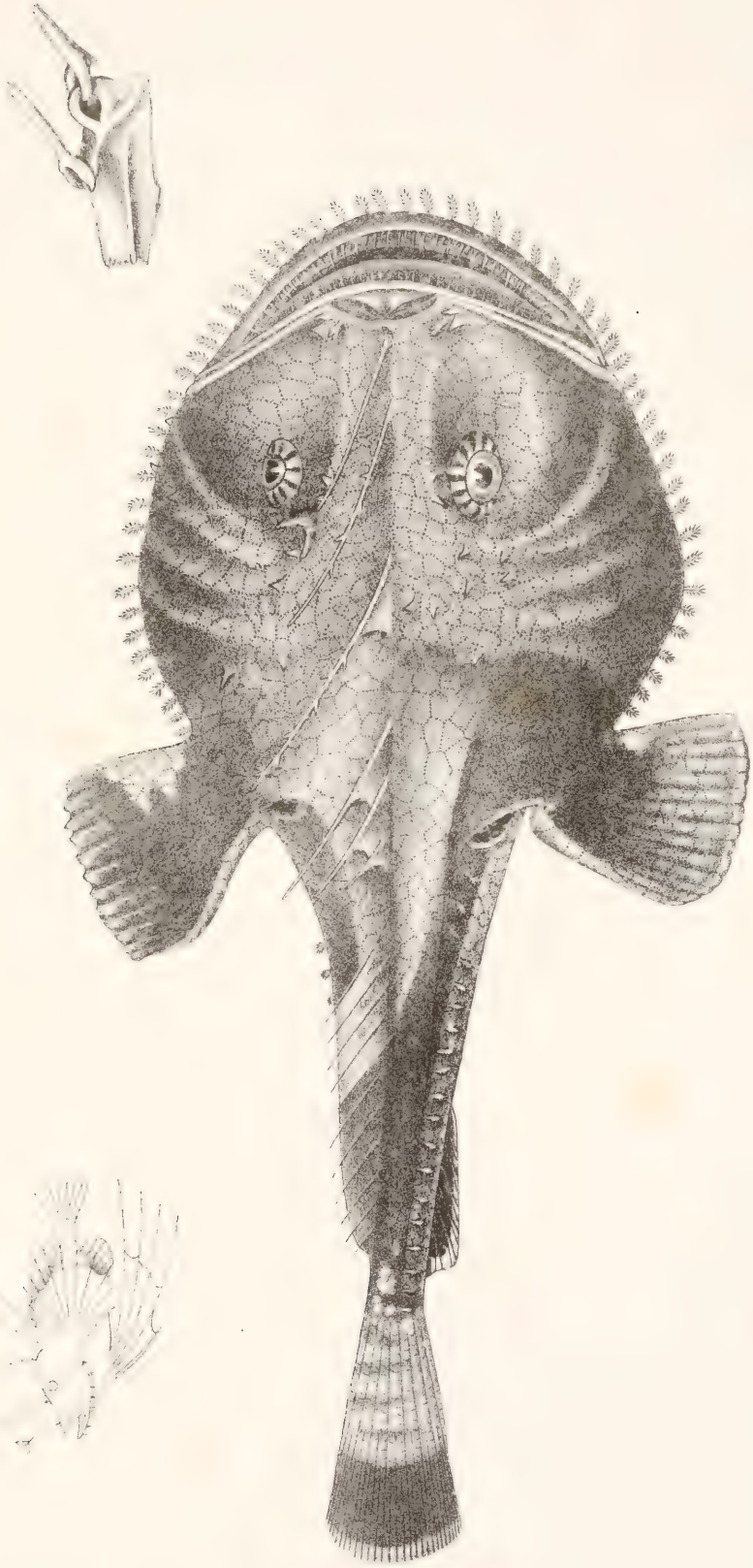
TRIGLA OBSCURA
1a Air-bladder 1b Stomach and [illegible] appendages

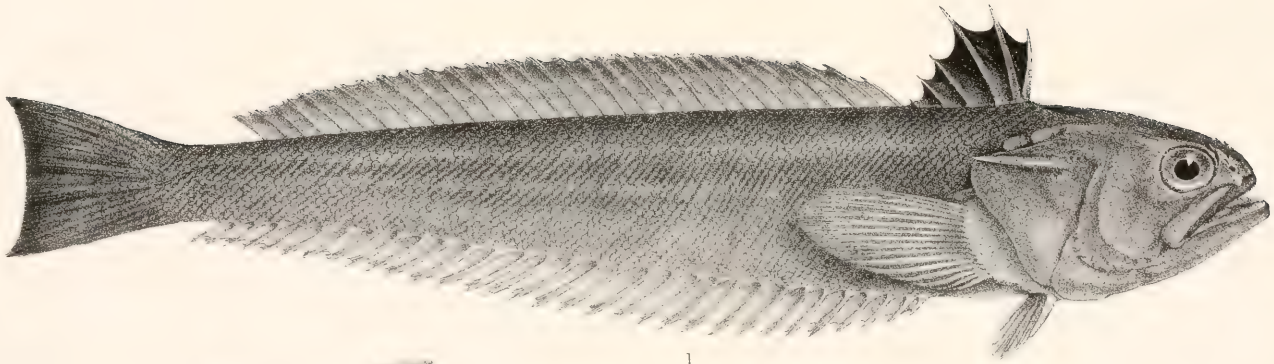


P. Day del. C. Achilles lith.

Mintern Bros. imp.

LAGONUS CATAPHRACTUS
1a Stomach and caecal appendages
PERISTHEDUS CATAPHRACTUM
2a Upper surface of head 2b Section through body 2c Stomach and caecal appendages





1

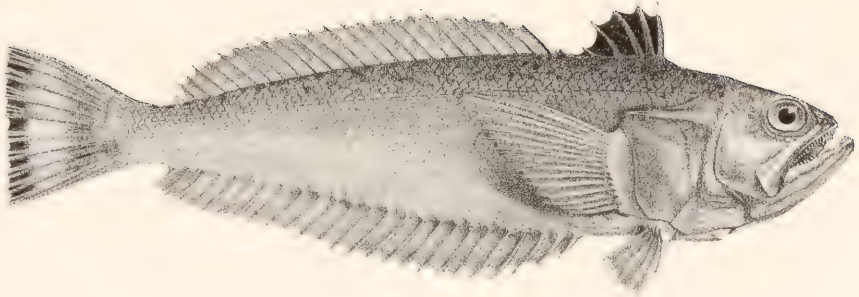
1a

F Day del. C. Achilles lith.

Mintern Bros imp.

1 TRACHINUS DRACO.

1a Stomach and cæcal appendages



Day del C Achilles lith.

TRACHINUS VIPERA

F Day del C Achilles lith

Mintern Bros imp

SCOMBER SCOMBER

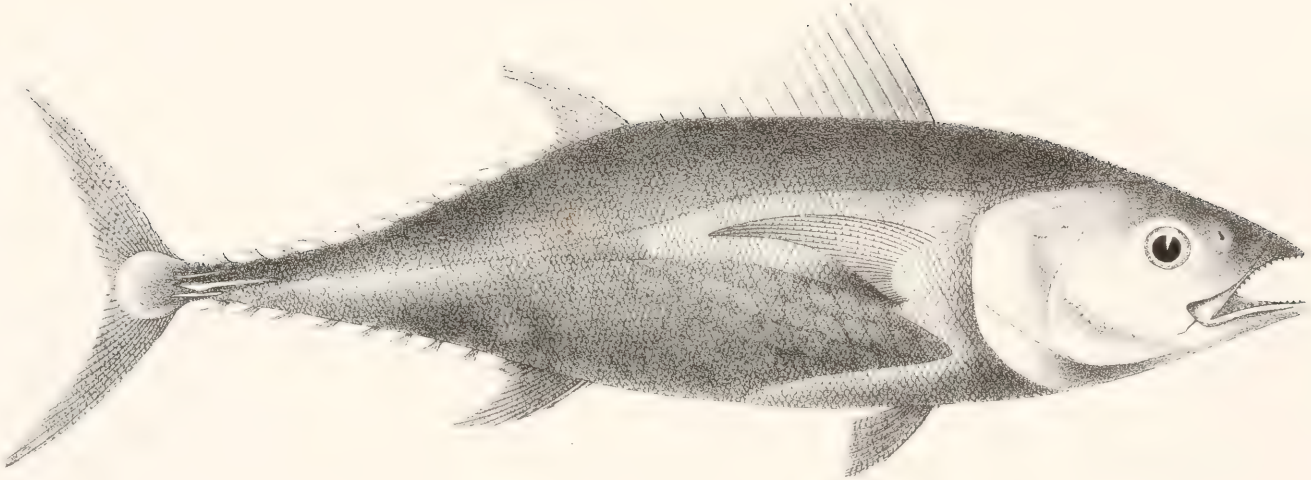
Mintern Bros. imp.

[illegible] SCOMBER [illegible] PUNCTATUS

[illegible]

[illegible]

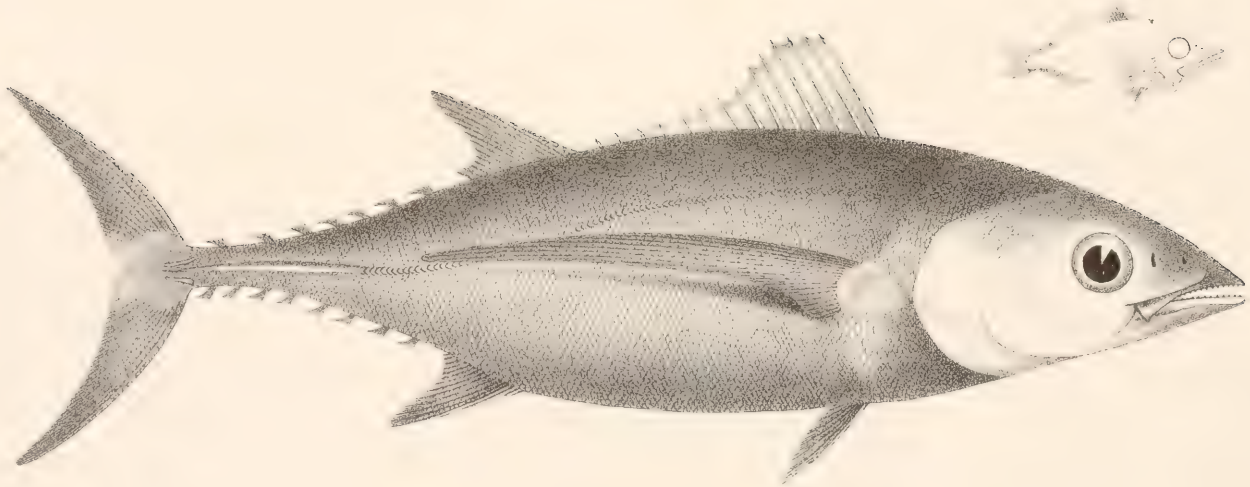
SCOMBER COLIAS



F Day del & Hanhart lith

Hanhart imp

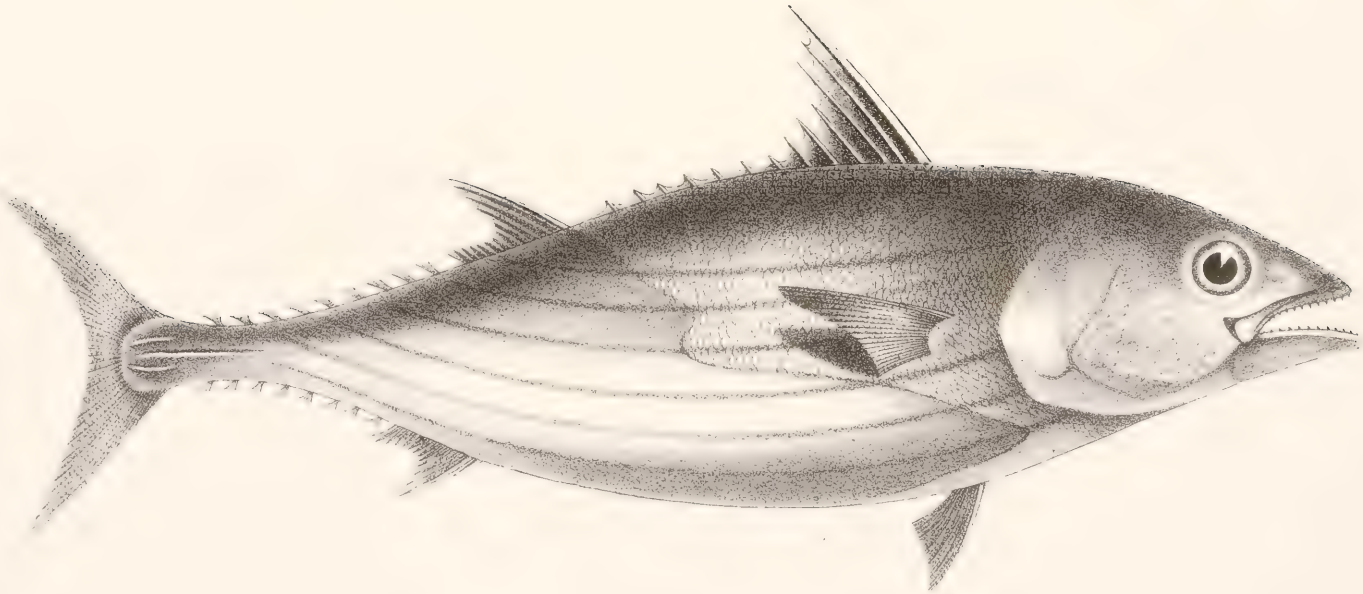
ORCYNUS THYNNUS



F. Day del. A. Hammond lith.

Haniart imp.

ORCYNUS GERMO



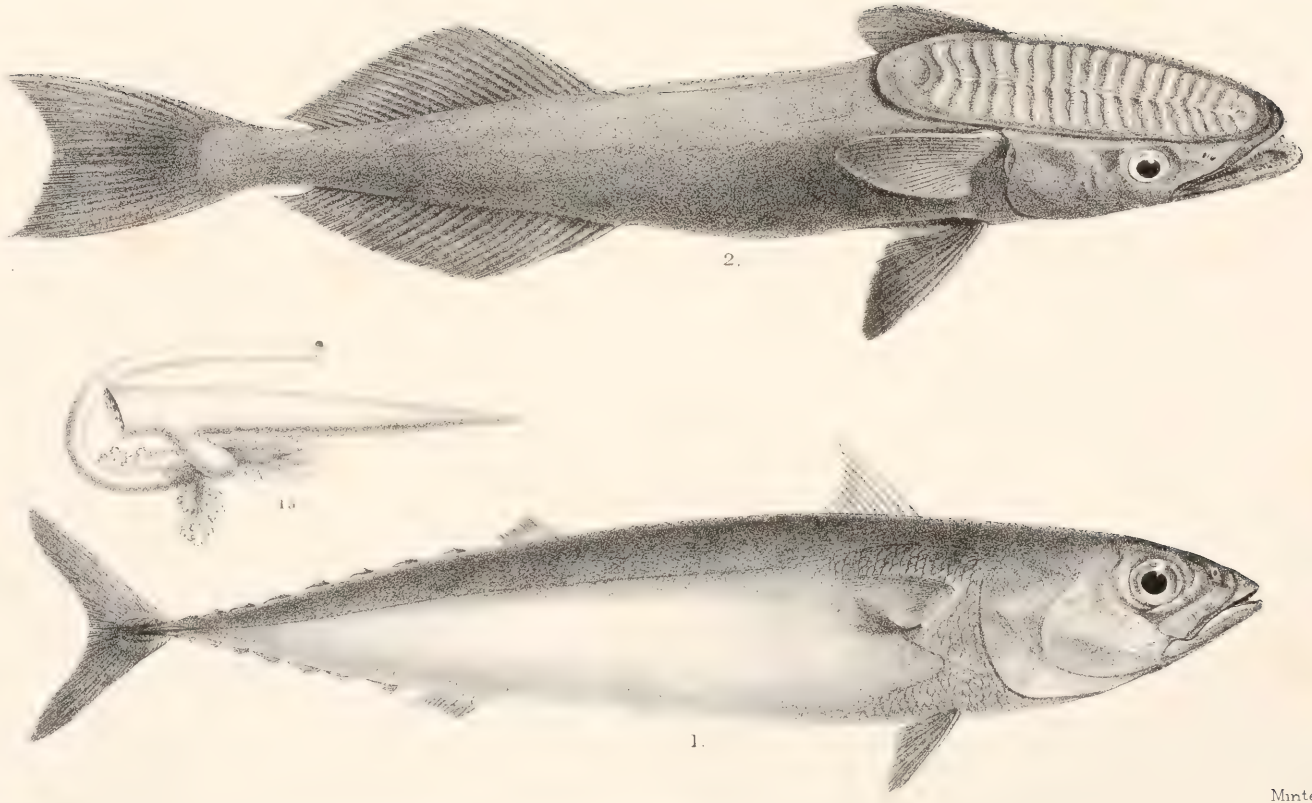
F Day del A Hammond lith

THYNNUS PELAMYS

F. Day del. & Hammond lith.

Hanhart imp.

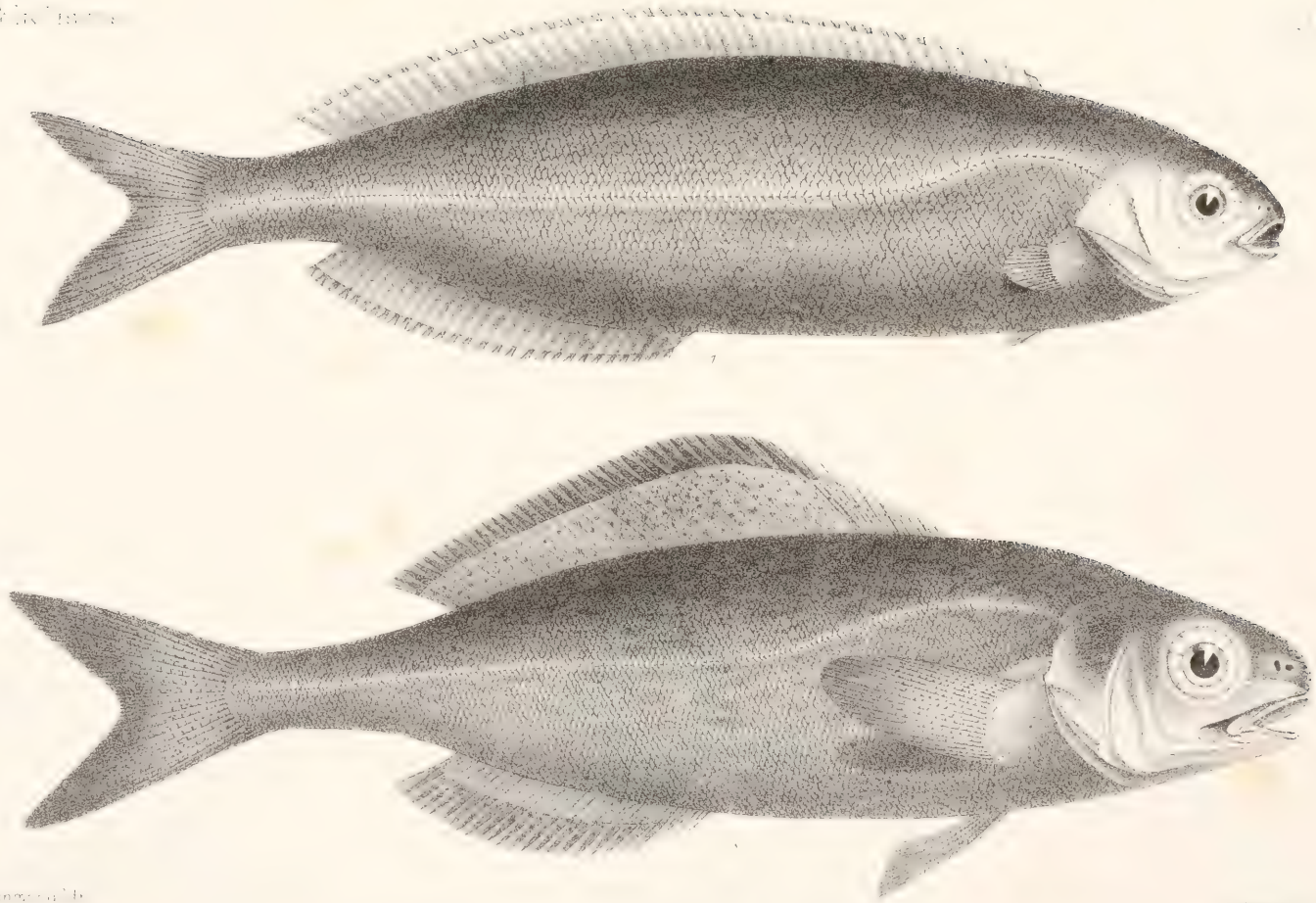
PELAMYS SARDA

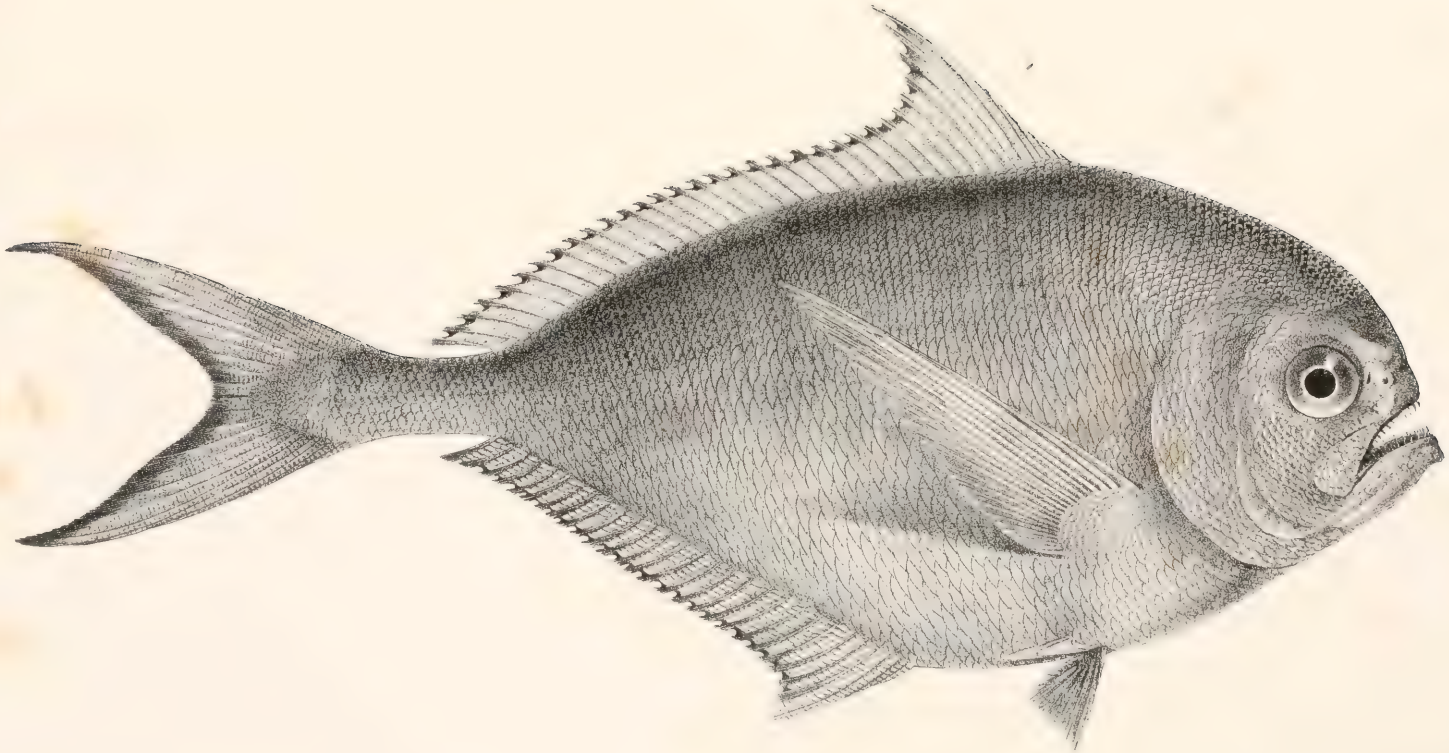


J. Bar. del. C. Achilles lith.

Mintern Bros. imp.

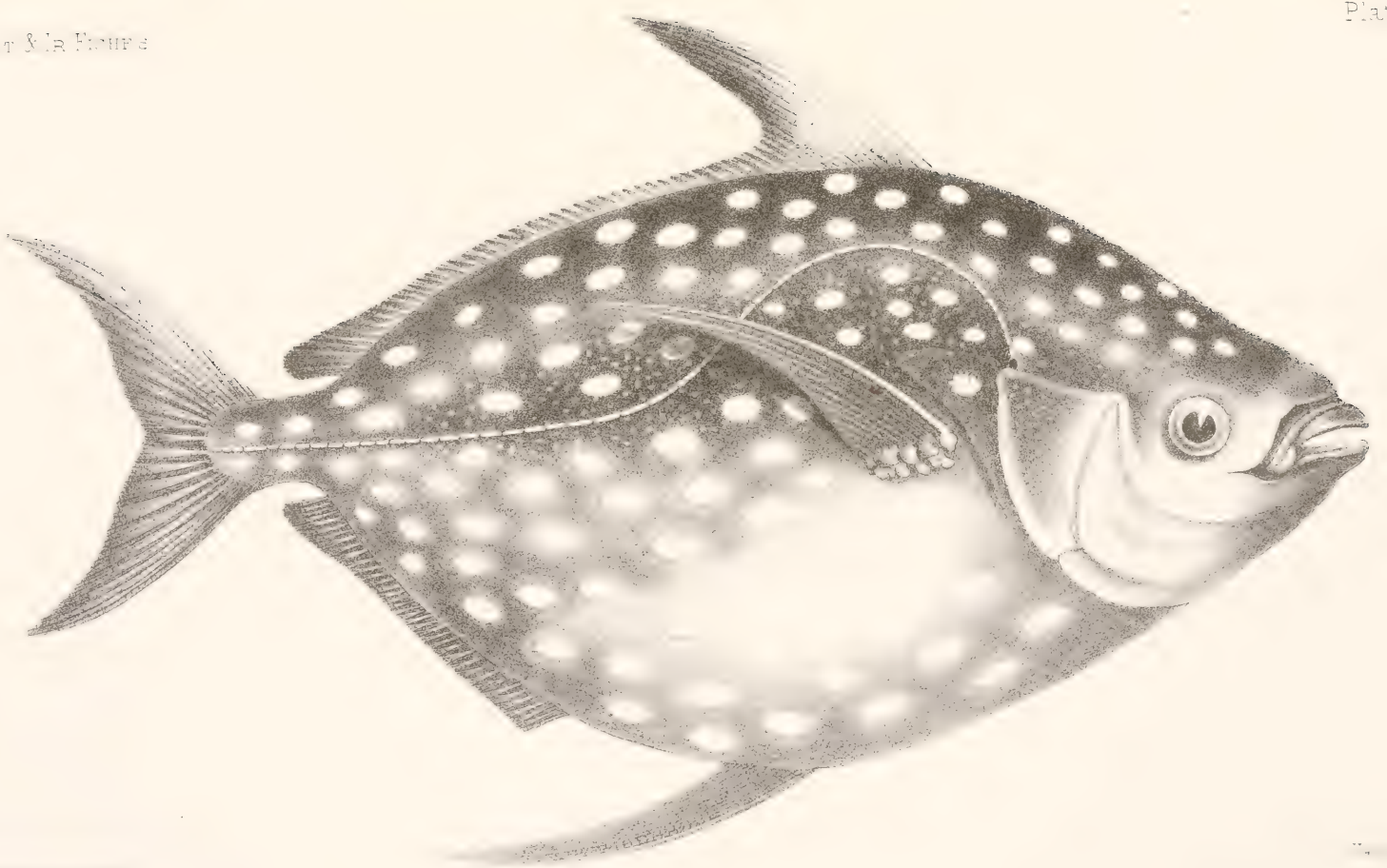
1 AUXIS ROCHEI 1a Stomach and cæcal appendages 2 ECHENEIS REMORA





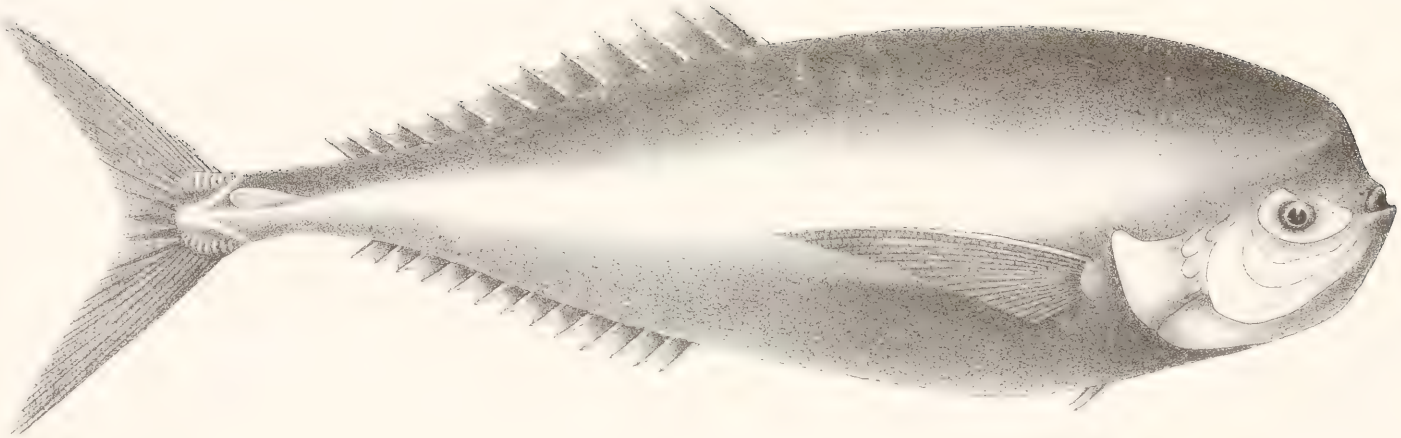
r Day del C Achilles lith

BRAMA RAYII.



Day del. A Hammond lith.

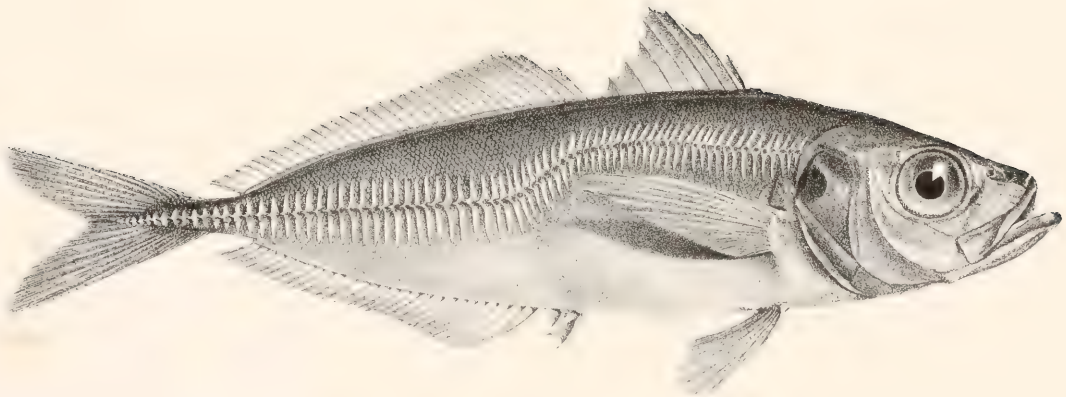
LAMPRIS [illegible]



Day del A Hammond lith

Hanhart imp

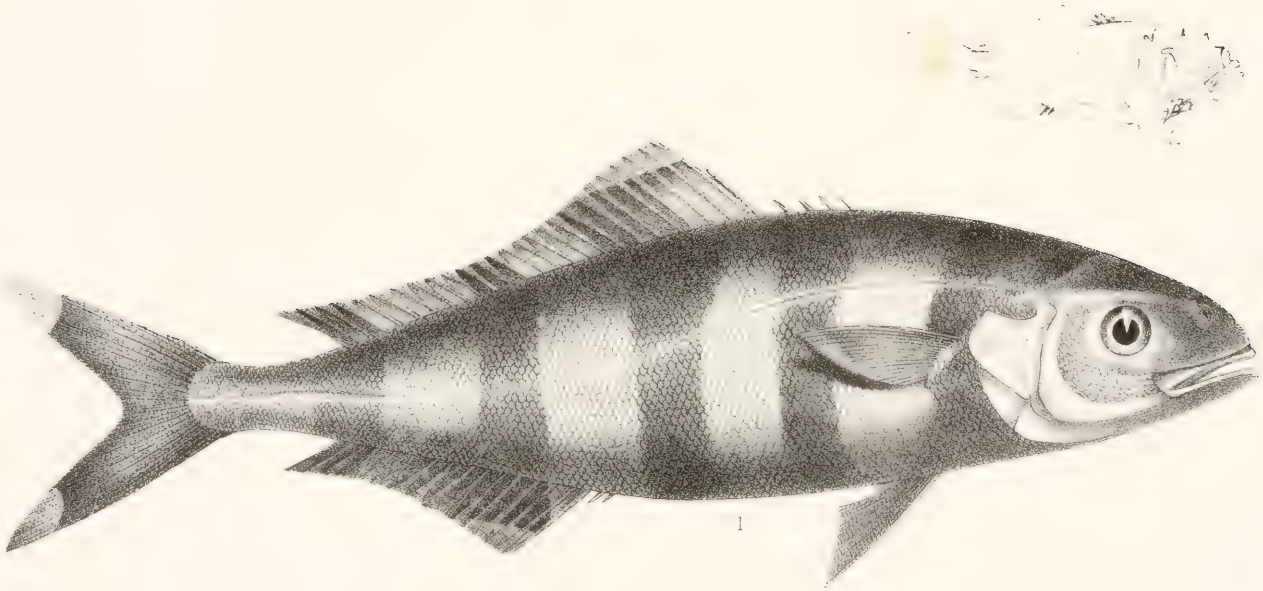
LUVARUS IMPERIALIS



F. Day del. C. Achilles lith.

Mintern Bros. imp.

TARANNA TRACHURUS



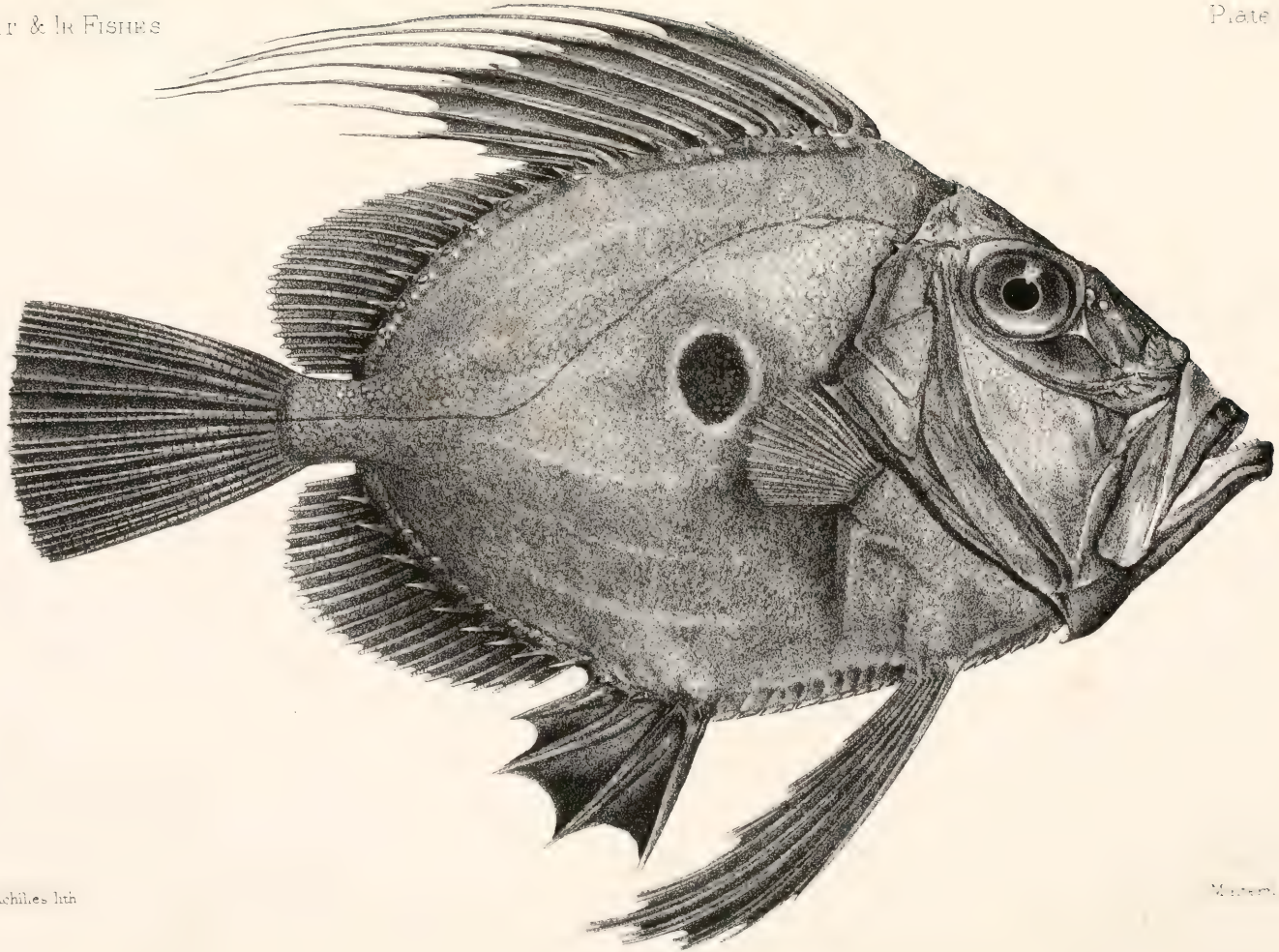
1 NAUCRATES DUCTOR 2 YOUNG

F Day del C Achilles lith

Mintern Bros imp

[illegible]CHIA GLAUCA 2 CAPROS AFER

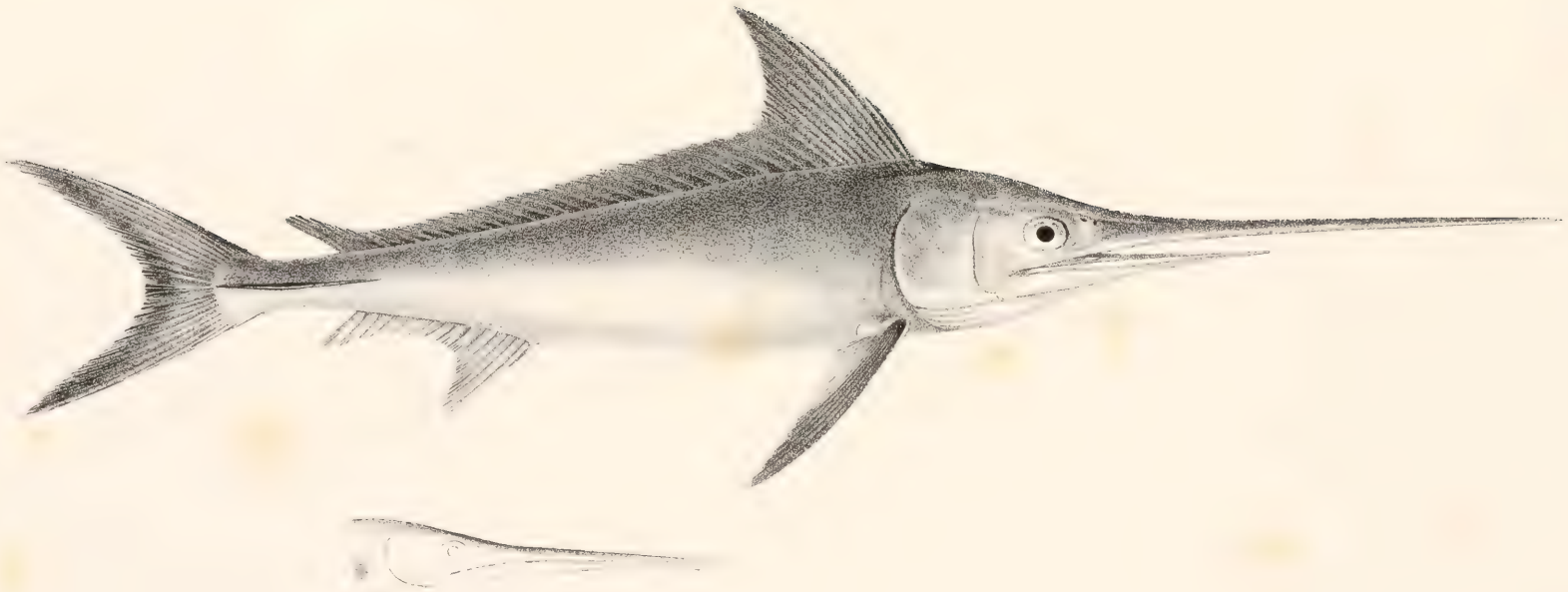
2a Stomach and cæcal appendages



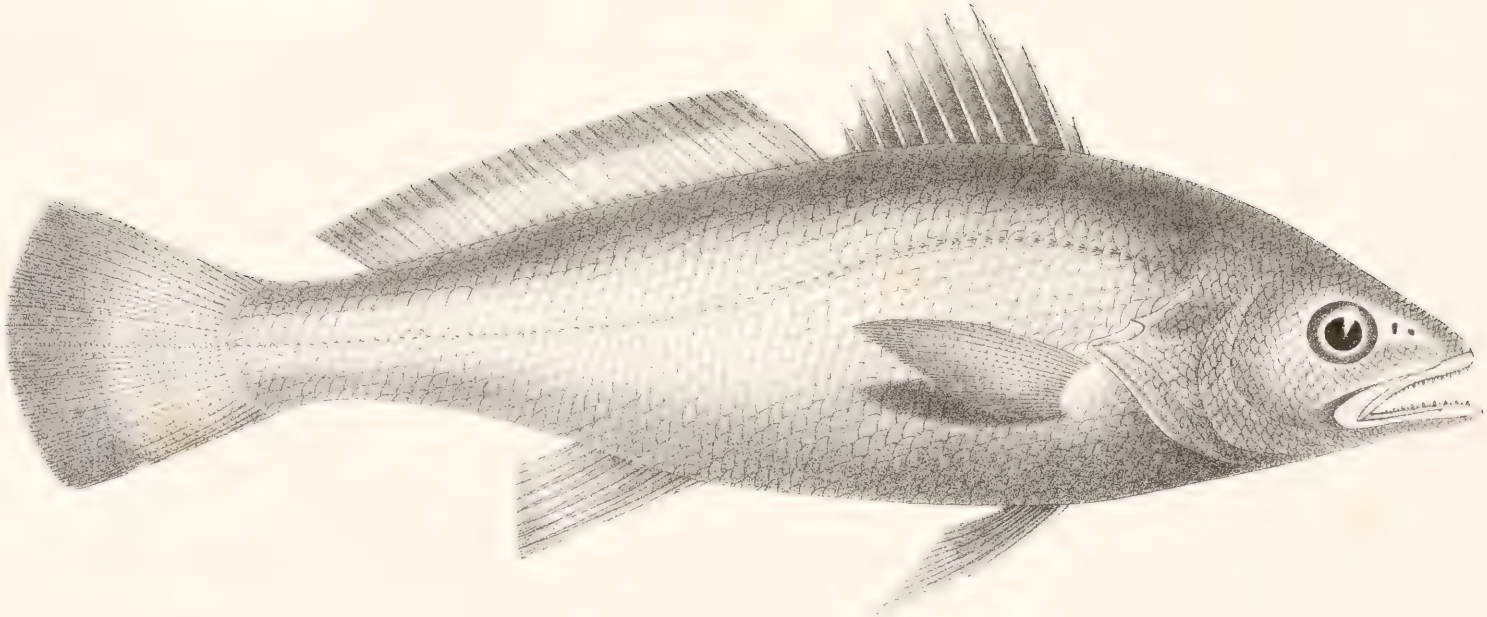
F Day del C Achilles lith

Malvern Bros imp

ZEUS FABER.



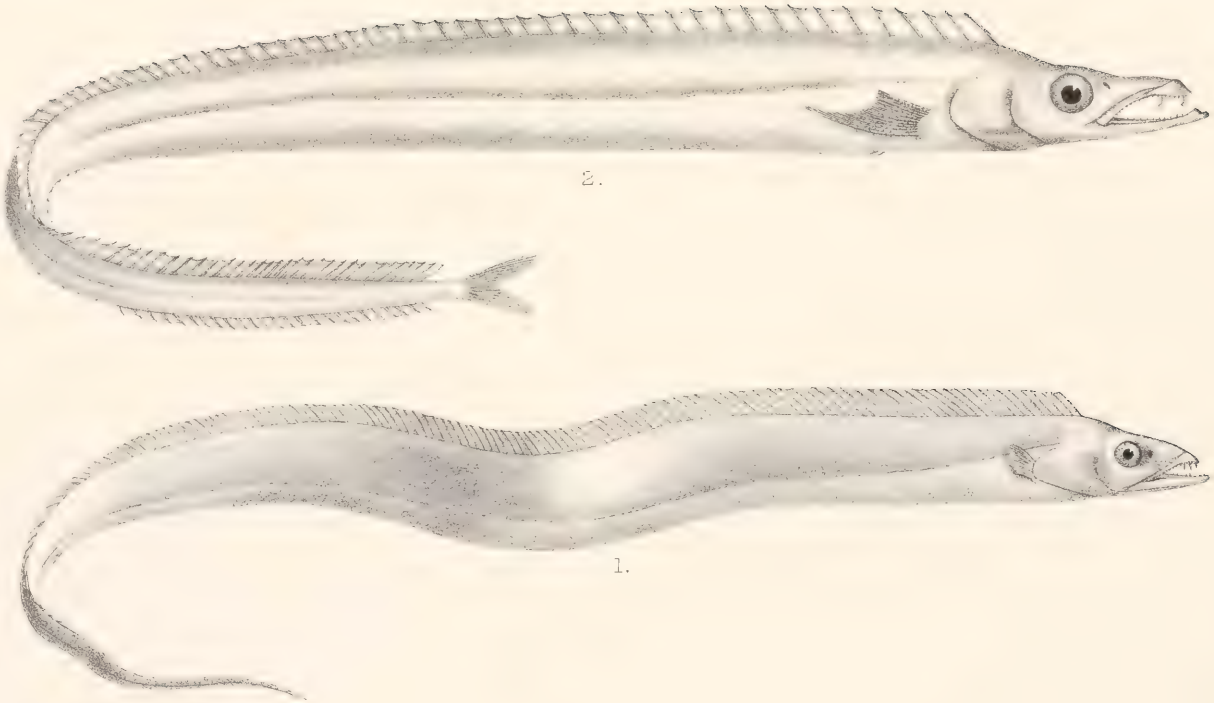
1. XIPHIAS GLADIUS. 2. (YOUNG)



Dep. de. A Hammond lith.

Hanhart imp.

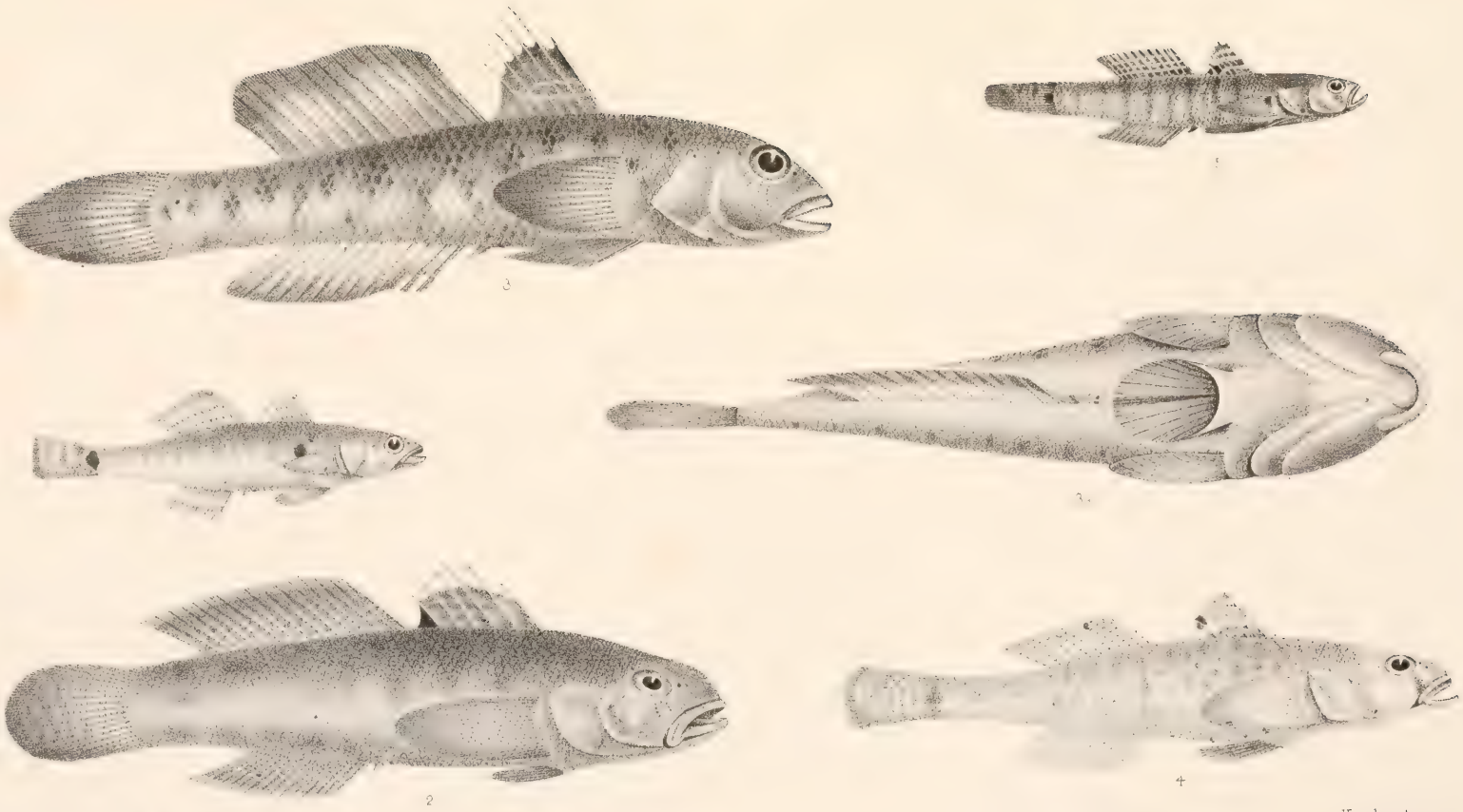
SCIÆNA AQUILA



F Day del.

Mintern Bros imp

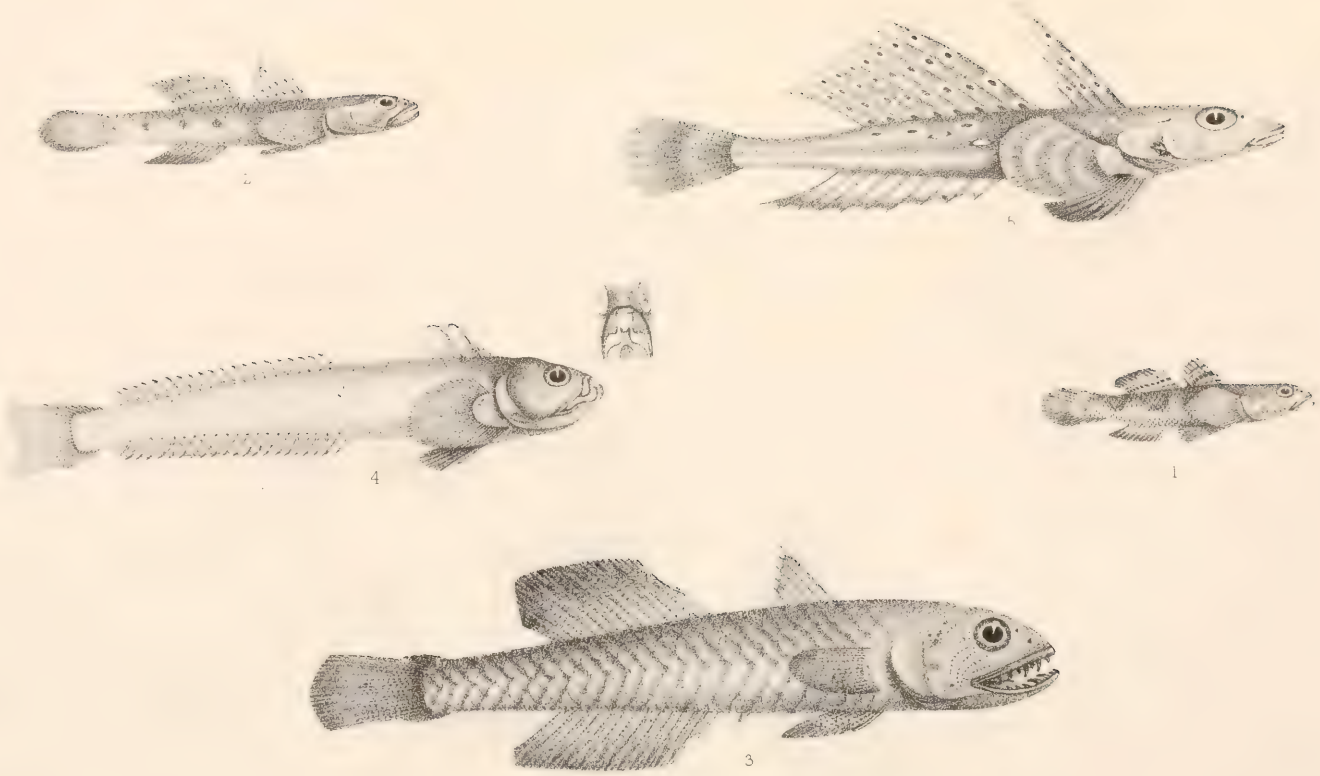
1. TRICHIURUS LEPTURUS. 2. LEPIDOPUS CAUDATUS.



F Day del A Hammond lith

Hanhart imp

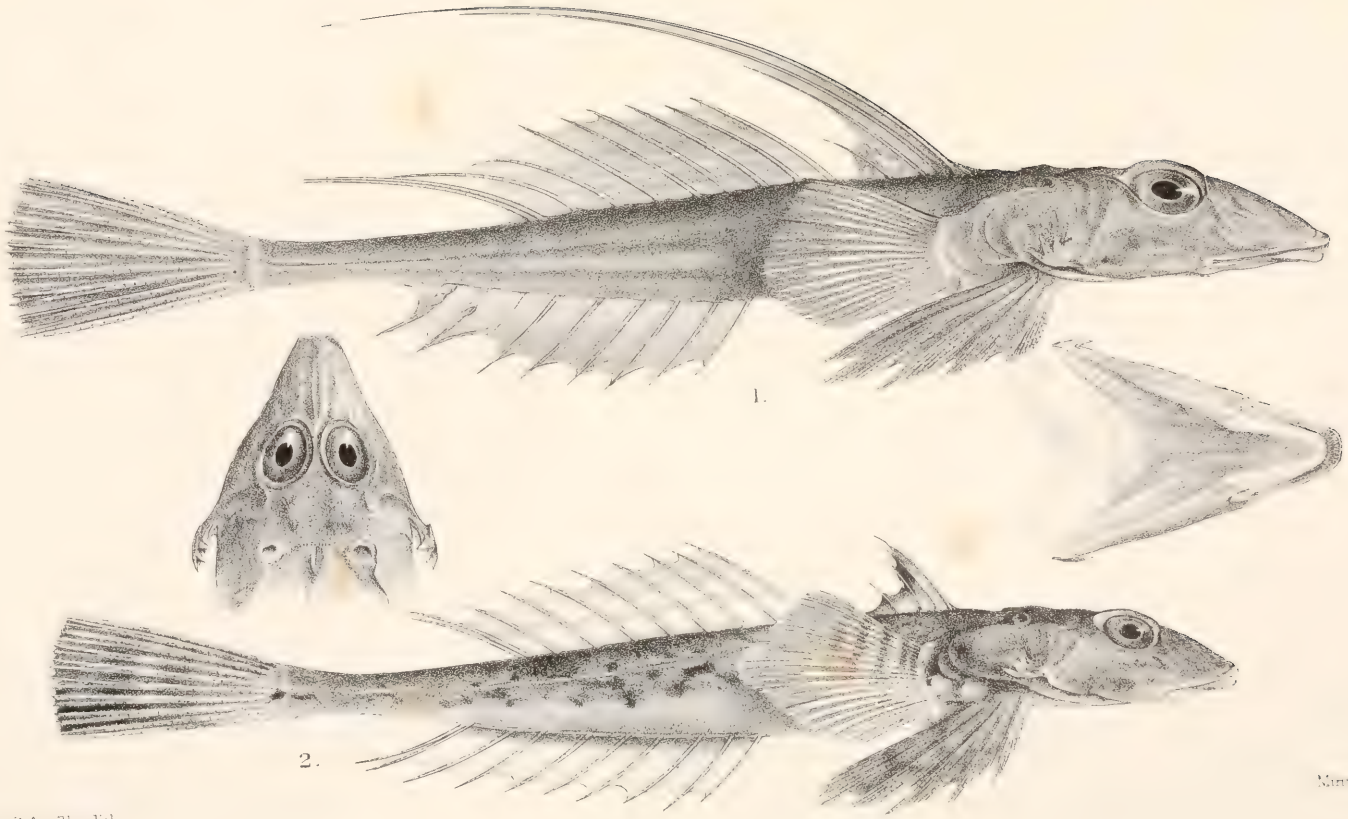
1 GOBIUS RUTHENSPARRI 2 G PAGANELLUS 3 G NIGER
4 G MINUTUS 5 G PARENTELLI



F Day del A Hammond lith

Barbard imp

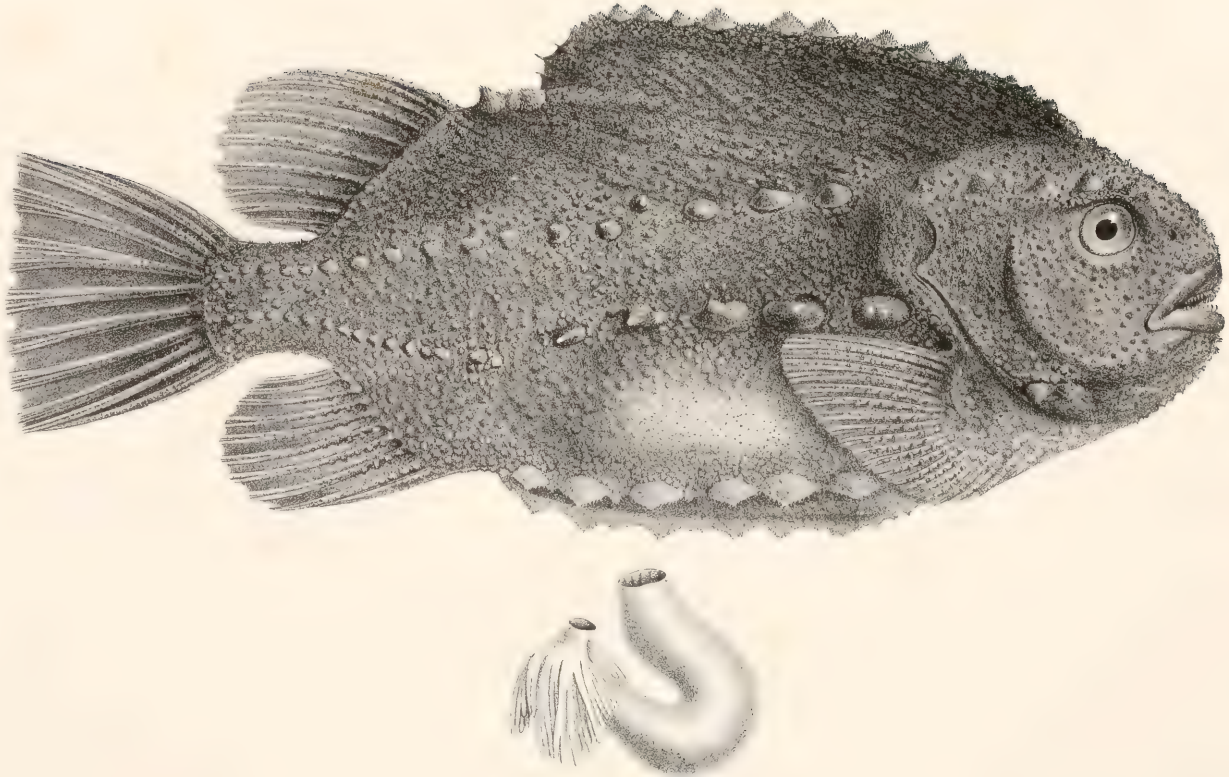
1. GOBIUS PICTUS 2. G. QUADRIMACULATUS 3. APHIA PELLUCIDA
(Male 4/1) 4. CRYSTALLOGOBIUS NILSSONII (Male 7). 5. CALLIONYMUS MACULATUS



Day del. C Achilles lith

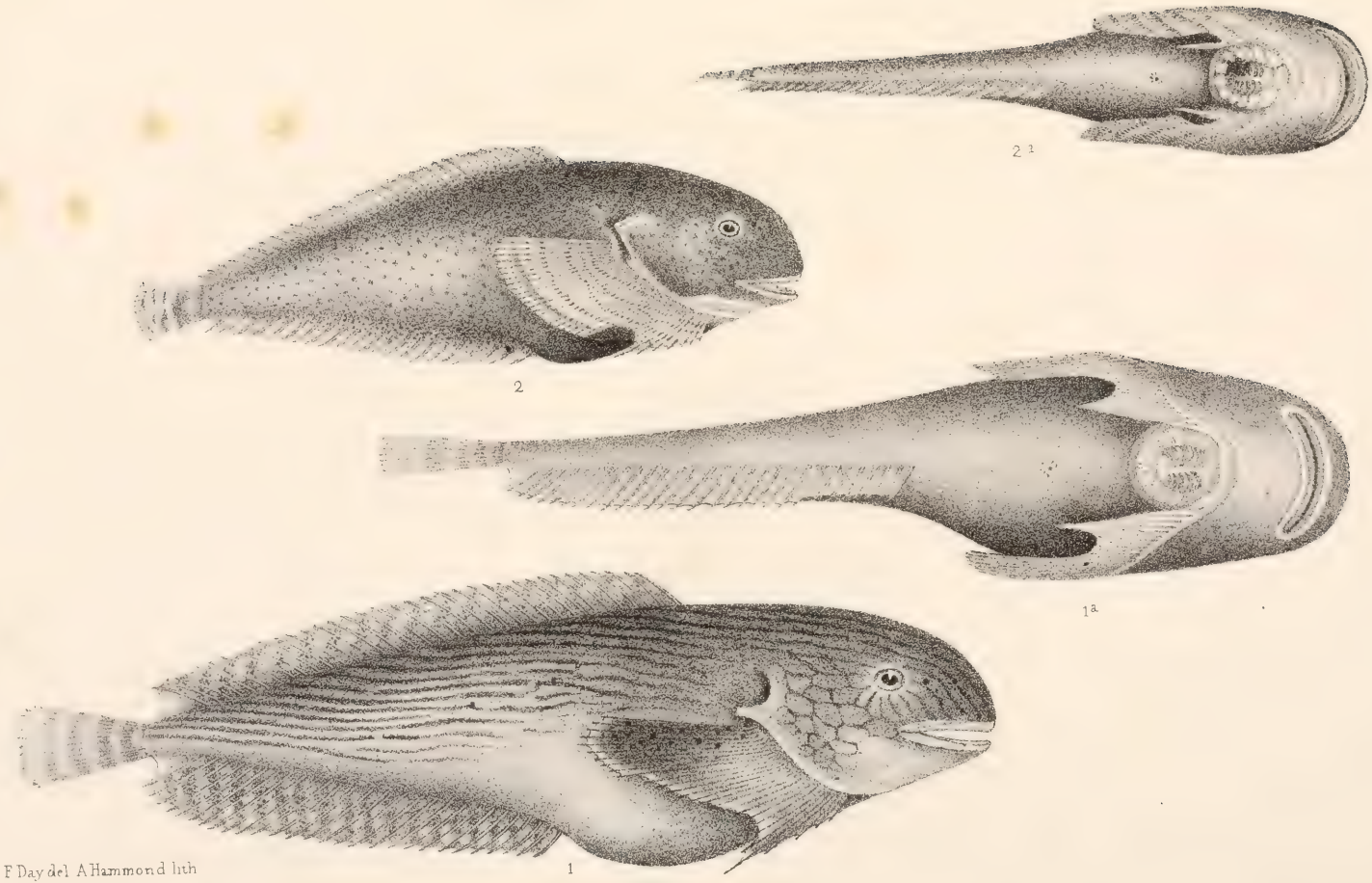
Mintern Bros imp

1 CALLIONYMUS LYRA. (MALE.) [illegible]



[illegible] Mintern Bros. imp.

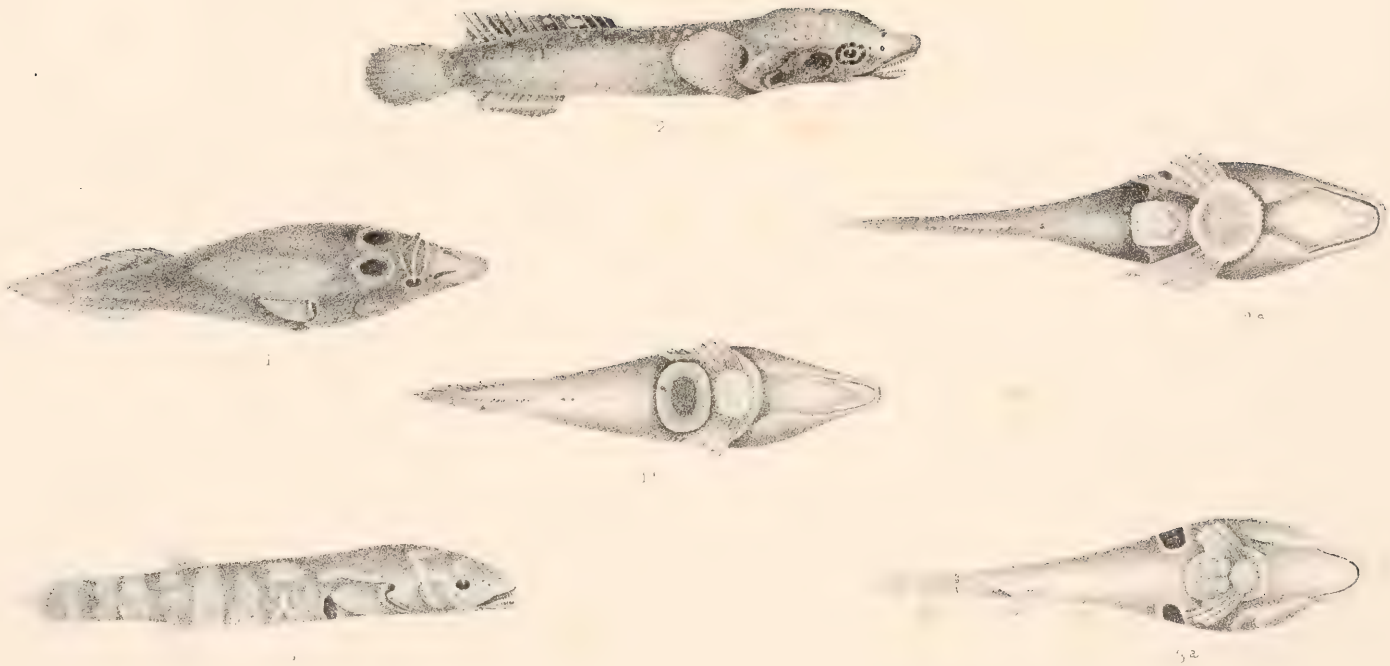
CYCLOPTERUS LUMPUS.



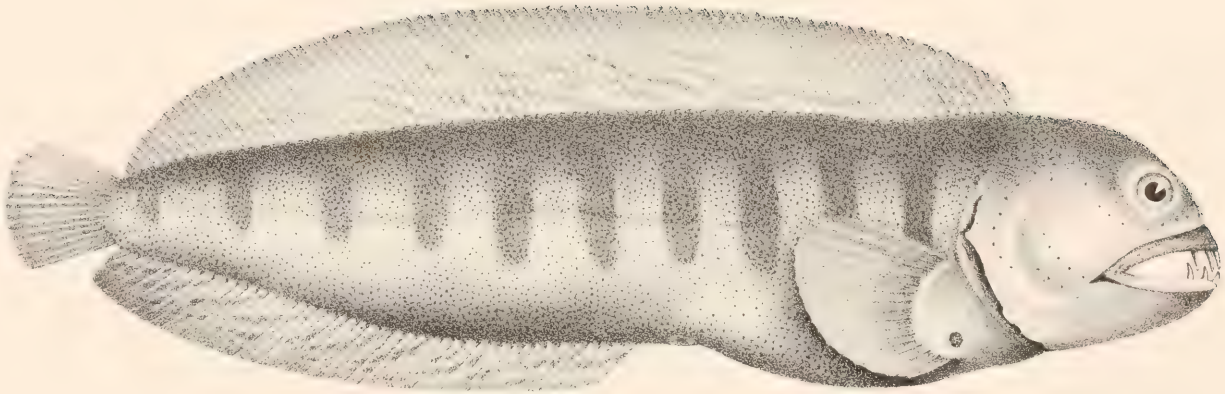
F Day del A Hammond lith

Hanhart imp

1 LIPARIS VULGARIS 2 L MONTAGUI.



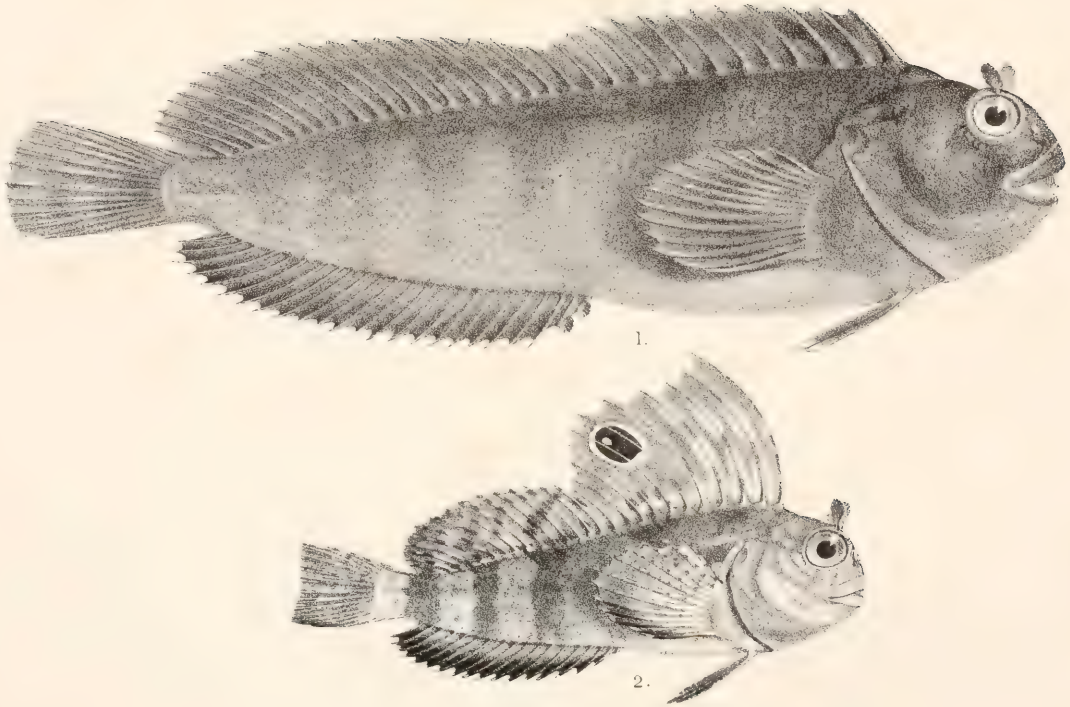
1. LEPADOGASTER GOUANII. 2. L. DECANDOLII. 3. L. BIMACULATUS (?)



F Day del A Hammond lith

Hanhart imp

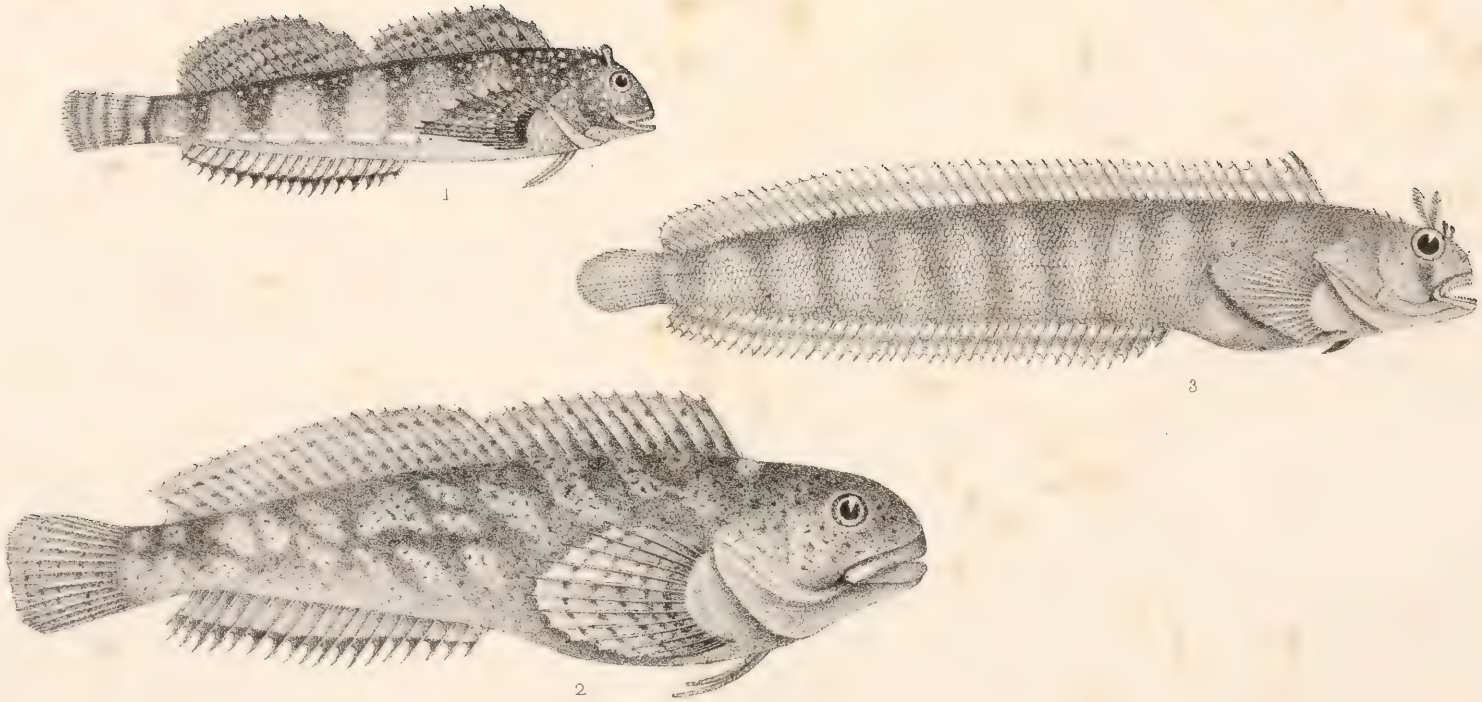
ANARRHICHAS LUPUS



F. Day del. C. Achilles lith.

Nuttern Bros. imp.

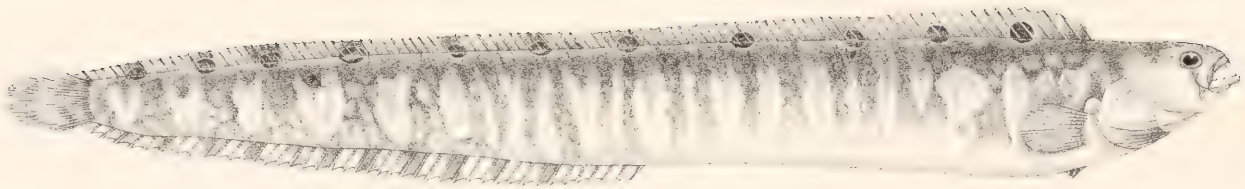
1. BLENNIUS GATTORUGINE. 2. B. OCELLARIS.



F Day del A Hammon Lith

Fannet imp

1 BLENNIUS GALERITA 2 B. PHOLIS. 3 CARELOPHUS ASCANII



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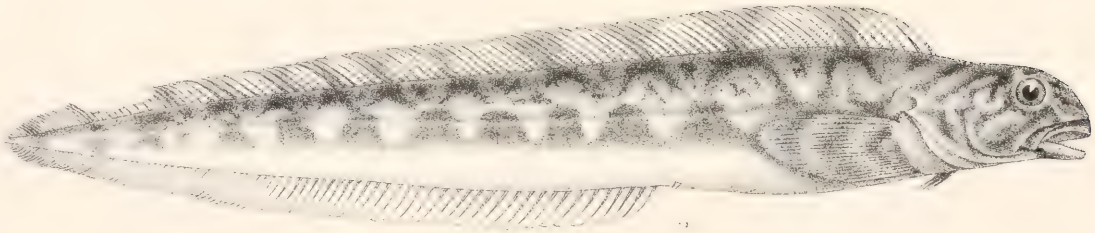
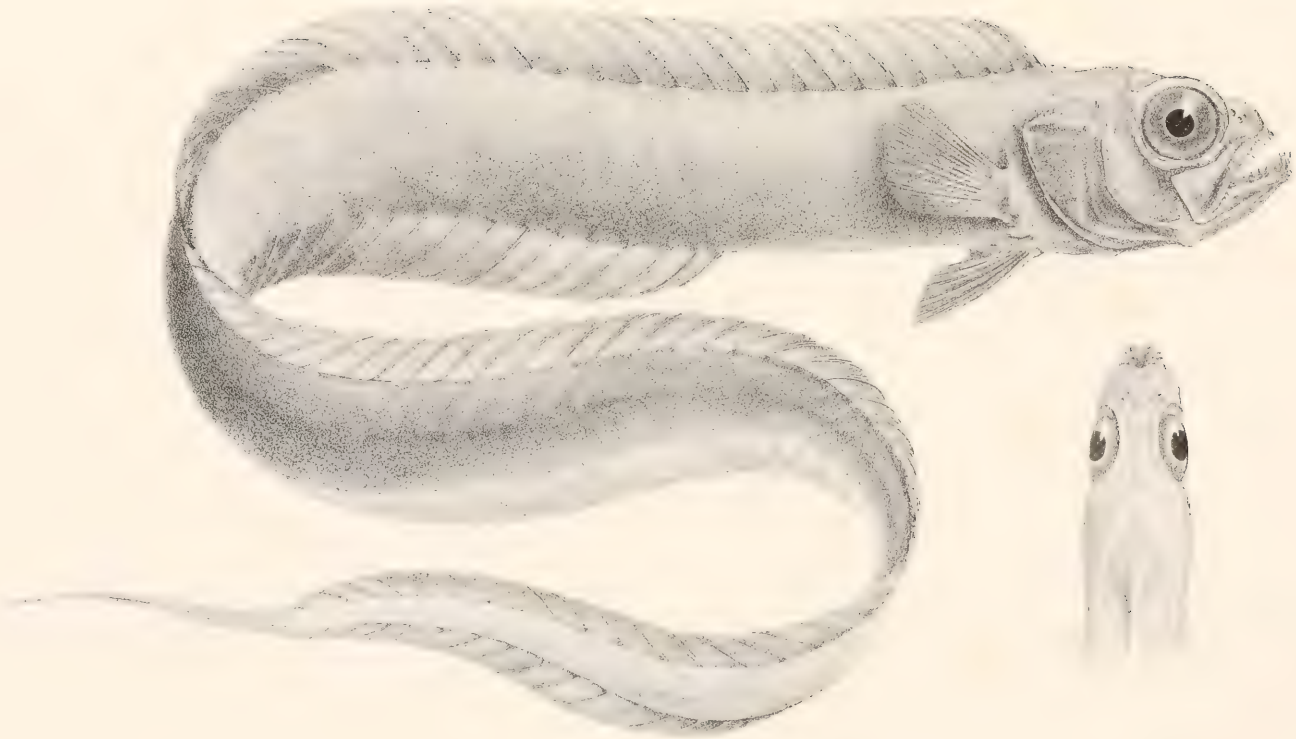


2.

F. Day del.

Mintern Bros. imp.

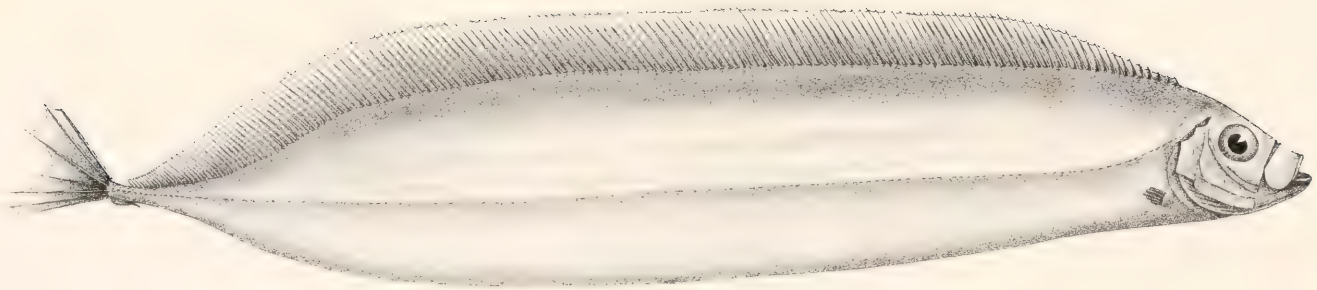
1. CENTRONOTUS GUNNELLUS. 2. ZOARCES VIVIPARUS.



F. Day del. C. Achille lith.

Mintern Bros. imp.

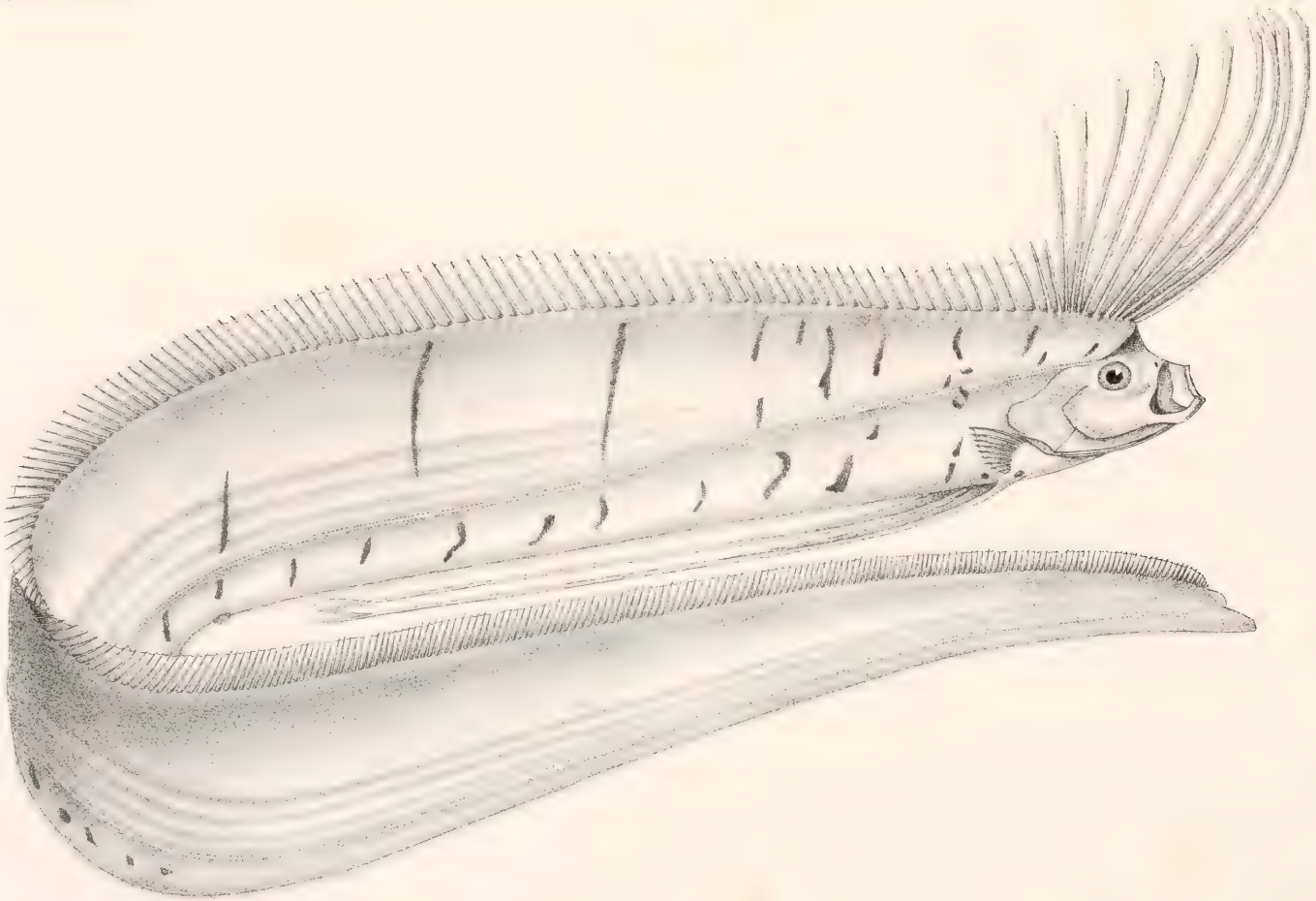
ERELA RUBESCENS.



F. [illegible] del.

Minter's Bro[illegible]

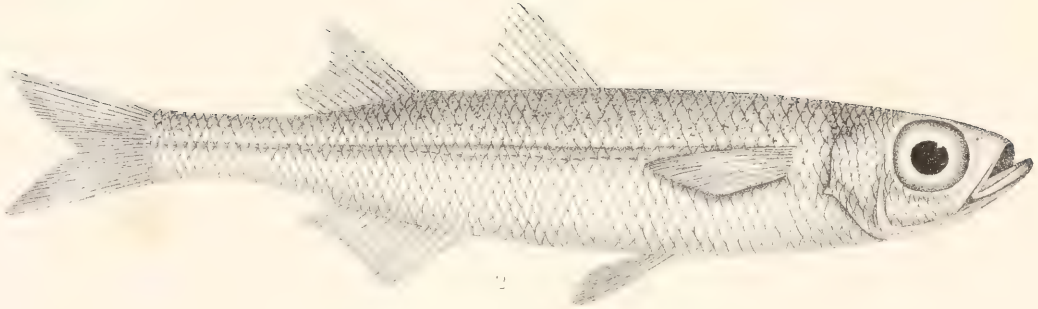
TRACHYPTERUS ARCTICUS.



Mintern Bro's imp.

Day del.

REGALECUS BANKSII.



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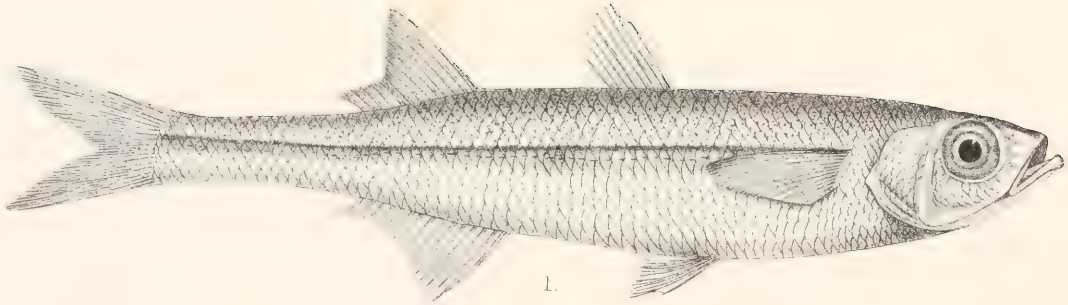
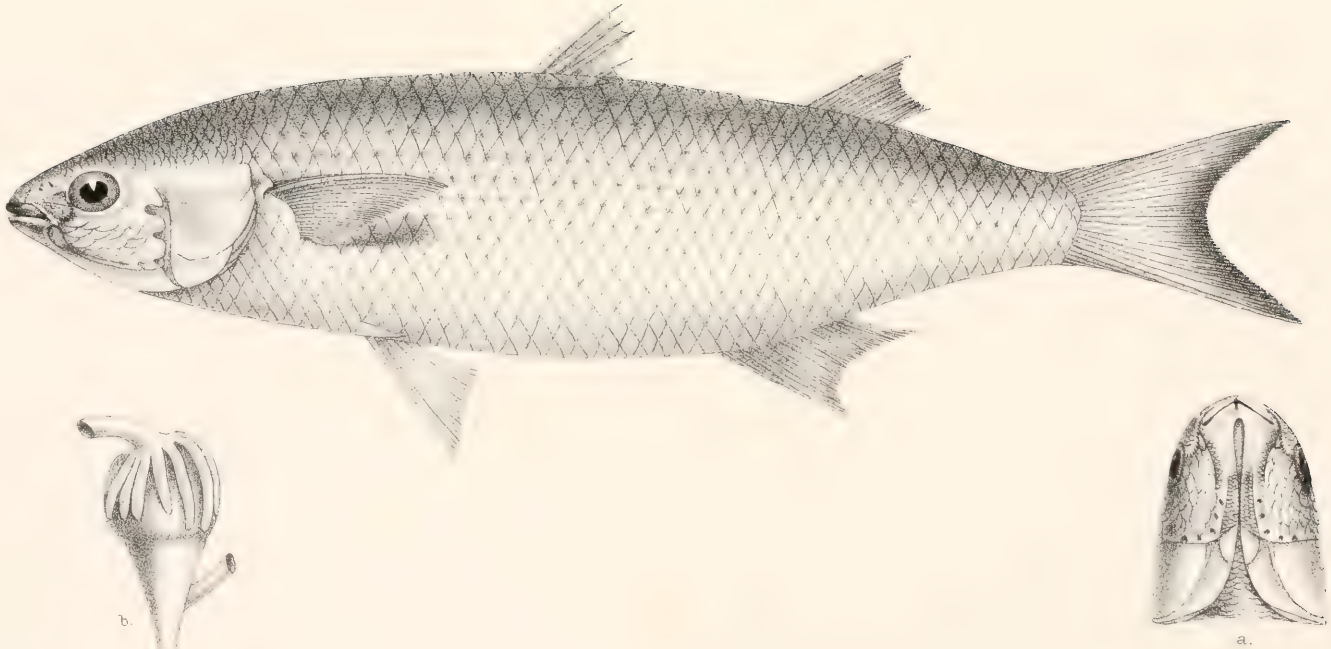


1.

1. ATHERINA PRESBYTER. 2. A. BOYERI.

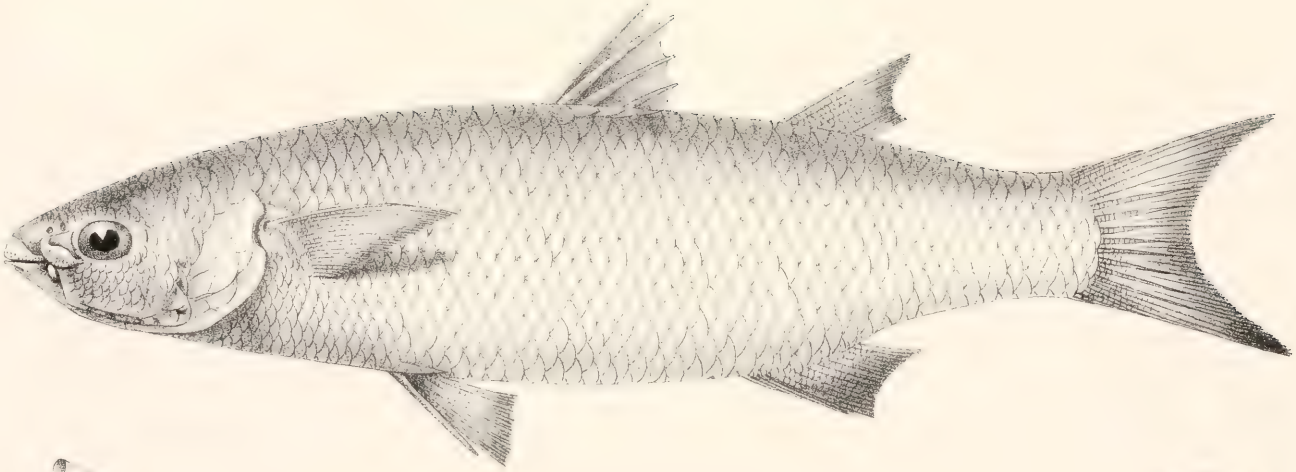
Mintern Bros imp.

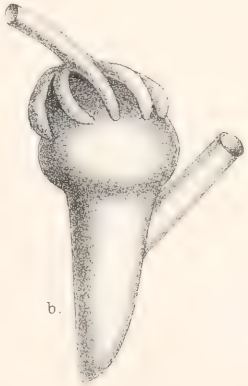


F Day del. Mintern Bros imp.

MUGIL CAPITO.

a. Under surface of Head. b. Stomach.

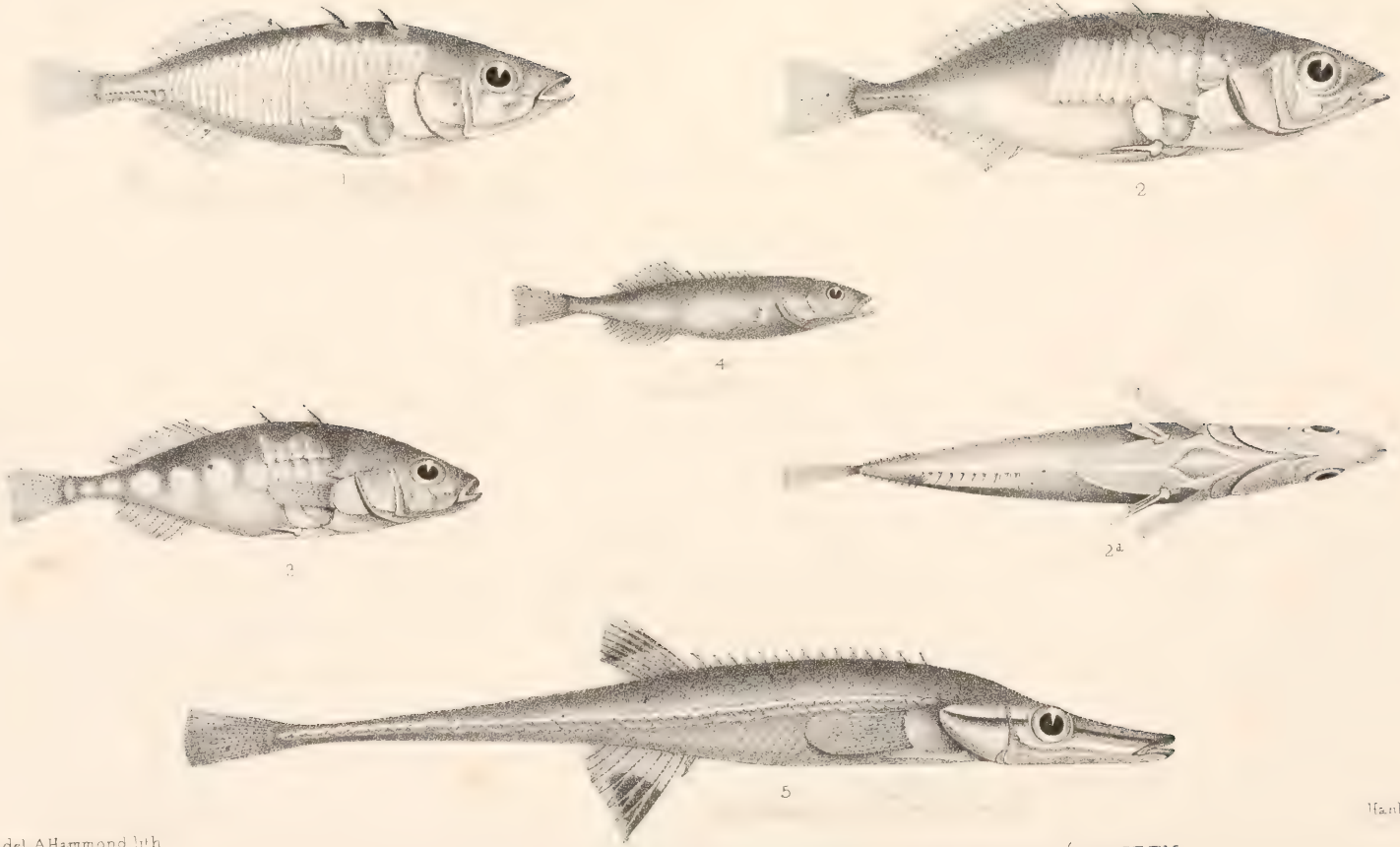




F Day del. Mintern Bro's imp.

MUGIL CHELO.

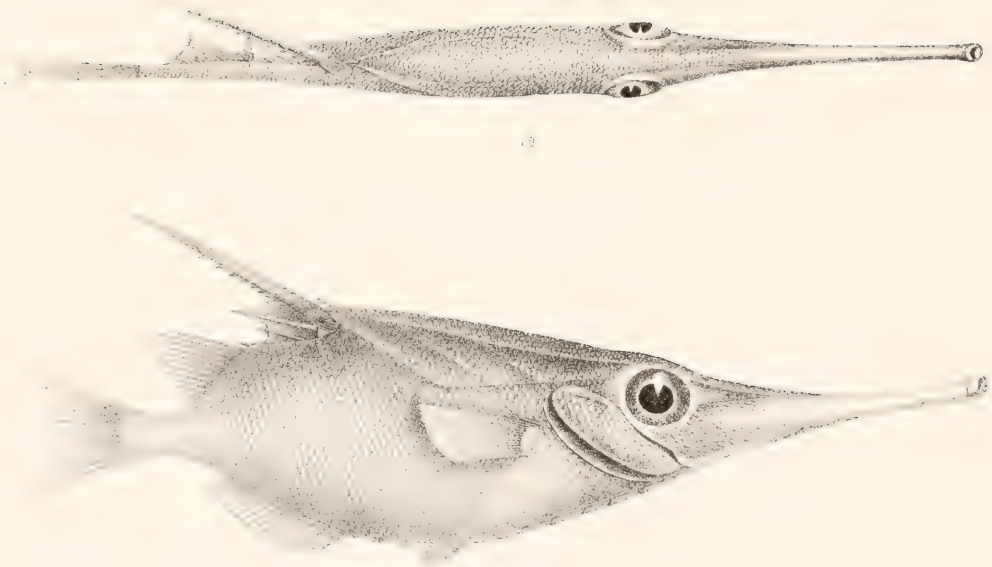
a. Under surface of Head. b. Stomach



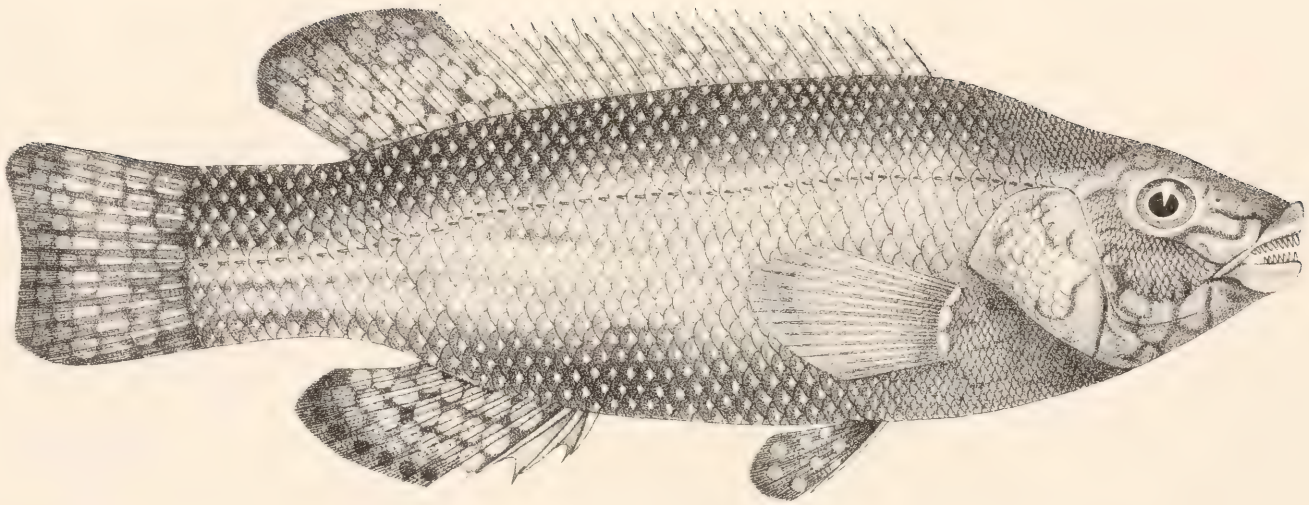
F Day del A Hammond lith

Hanhart imp

1 GASTEROSTEUS ACULEATUS,(VARIETY TRACHURUS.) 2 G ACULEATUS (VARIETY. SEMIARMATUS.) 3 G ACULEATUS,(VARIETY GYMNURUS.) 4 G PUNGITIUS,(VARIETY WANTING VENTRAL FINS.) 5 G SPINACHIA



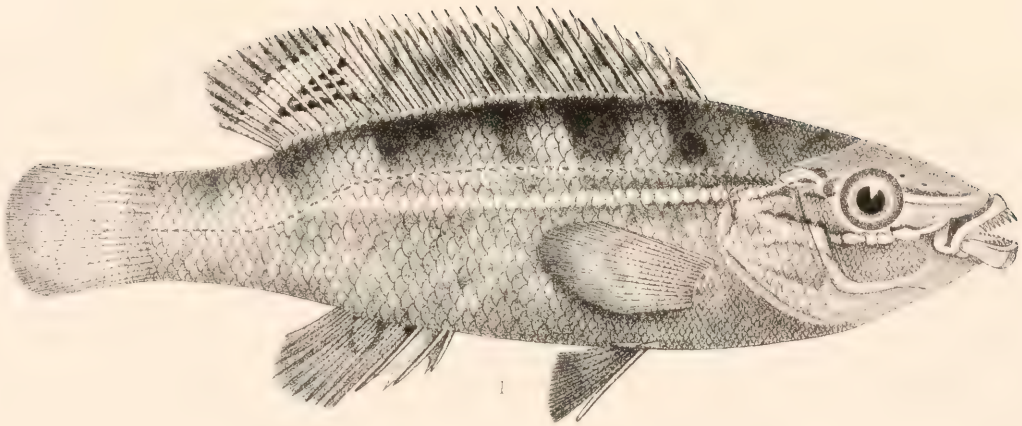
Hanhart

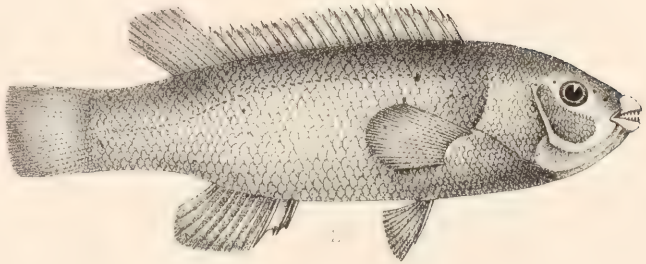


F Day del A Hammond sc

Hanhart imp

LABRUS MACULATUS

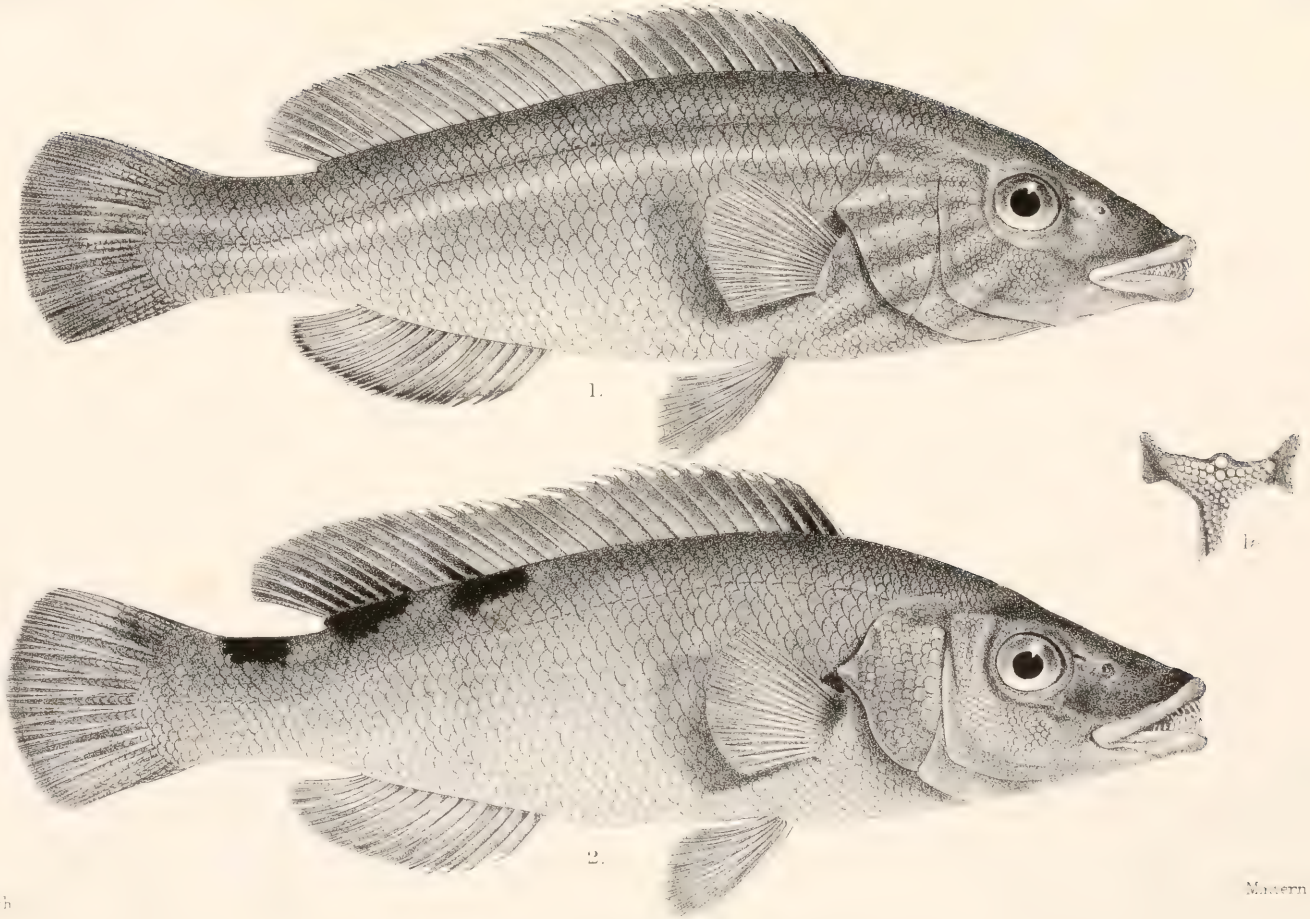




F. Day del. A. Hammond lith.

M. & N. Hanhart imp.

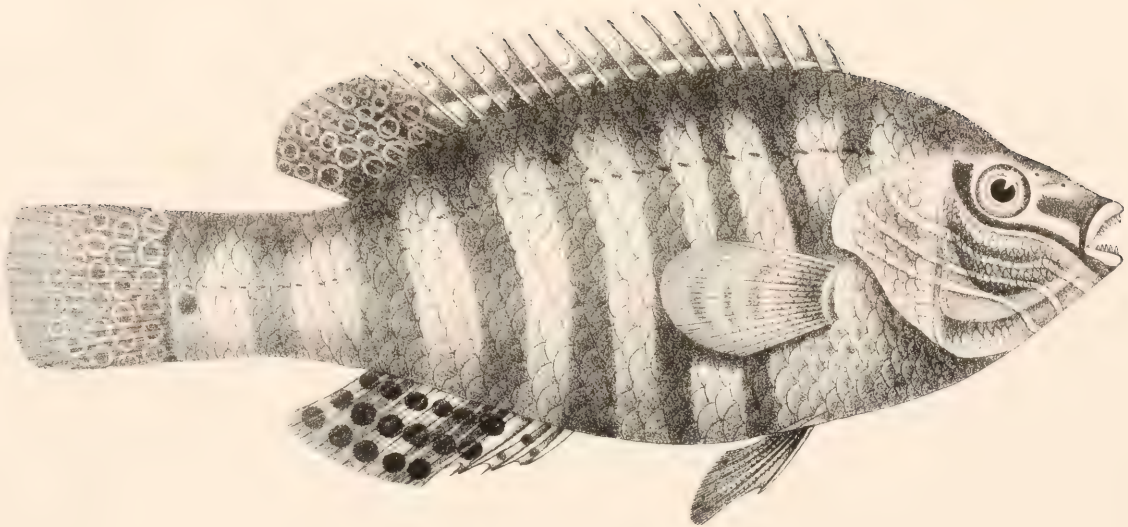
1 LABRUS MACULATUS (VARIETY DONOVANI)
2 L. MACULATUS (VAR. LINEATUS.)



F Day del. J Achilles lith.

Mintern Bros. imp.

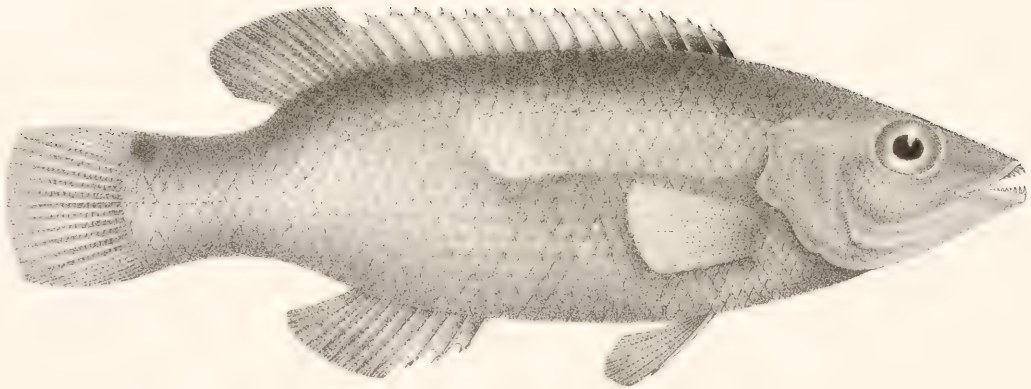
LABRUS MIXTUS. (1. MALE. 2. FEMALE.)
1a. Pharyngeal teeth.



F Dun del J Hamm and lith

M & N Hanhart imp

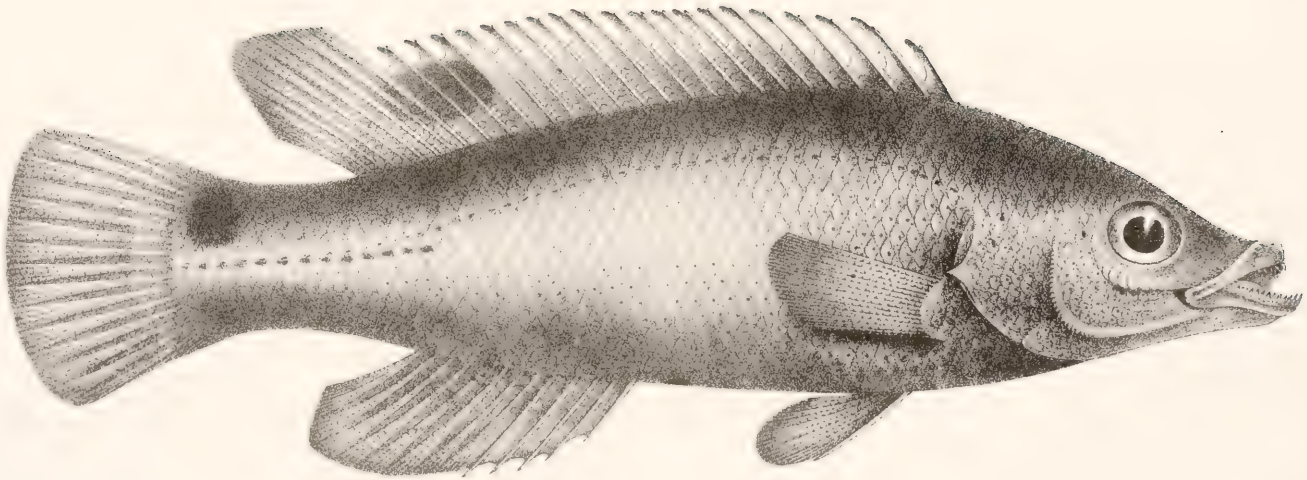
CRENILABRUS MELOPS



F Day del A Hammond lith

Hanhart imp

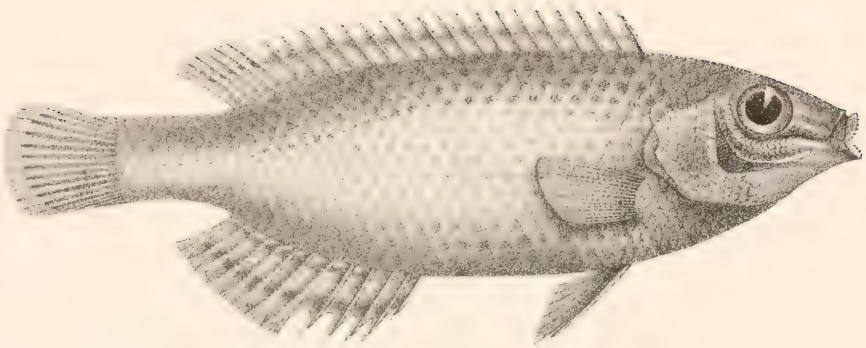
CTENOLABRUS RUPESTRIS



T. Dayd del. A. Hammond lith.

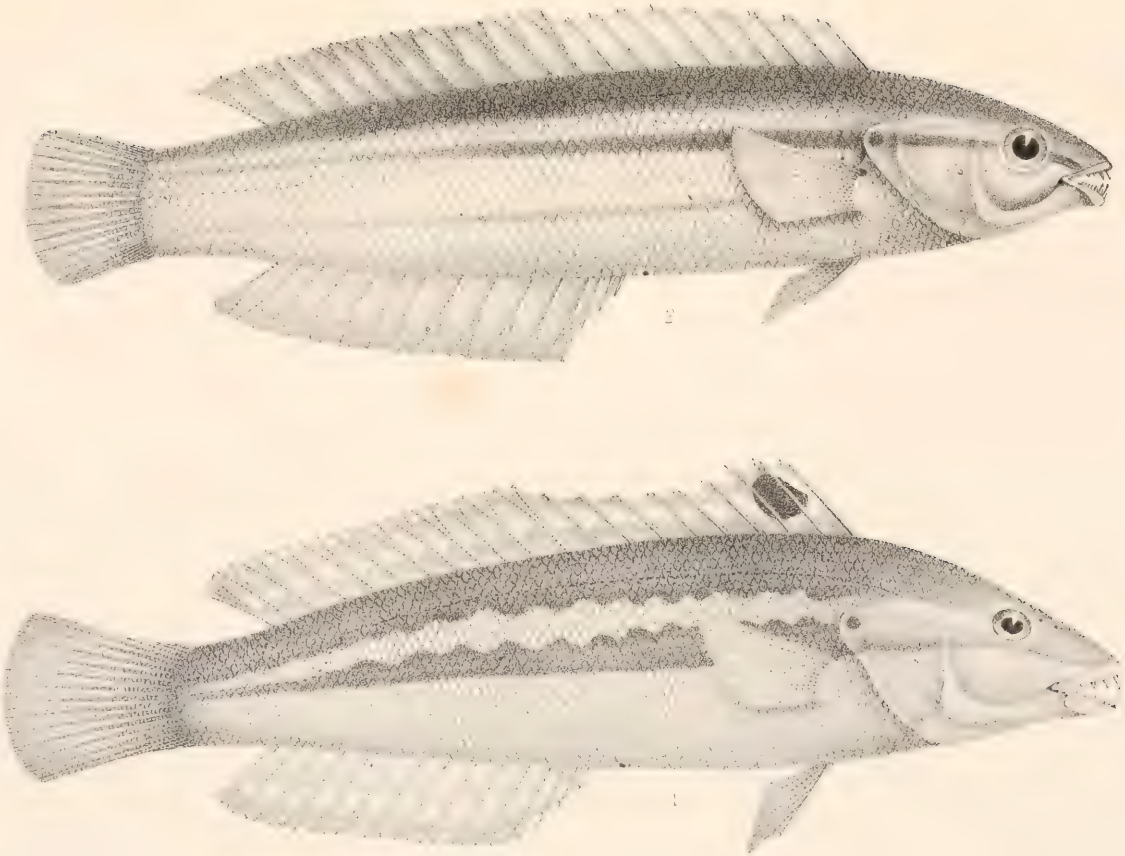
Hanhart imp.

ACANTHOABRUS PALLONI



F Day del A Hammond lith Hanhart imp

CENTROLABRUS EXOLETUS



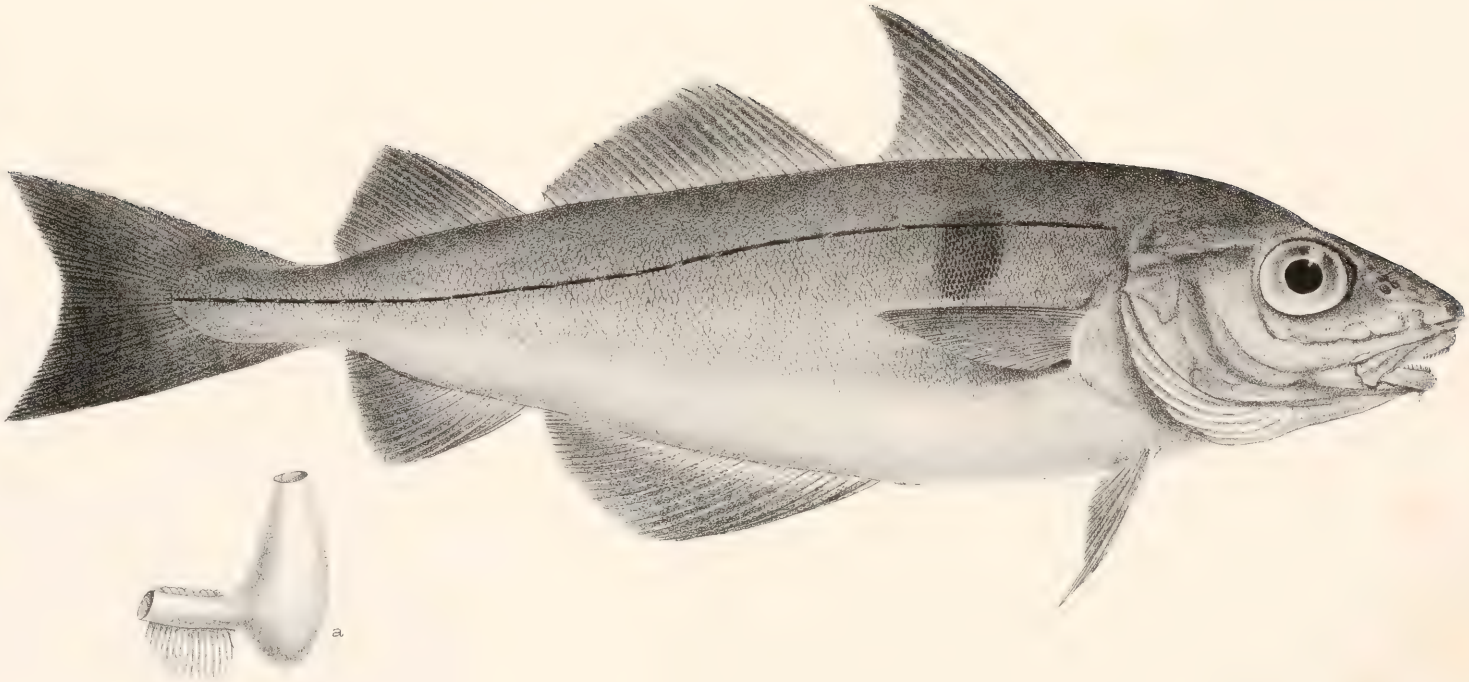
1 CORIS JULIS (MALE) 2 C. JULIS (FEMALE)

F. Day del. J. Achilles lith.

Mintern Bros. imp.

GADUS MORRHUA.

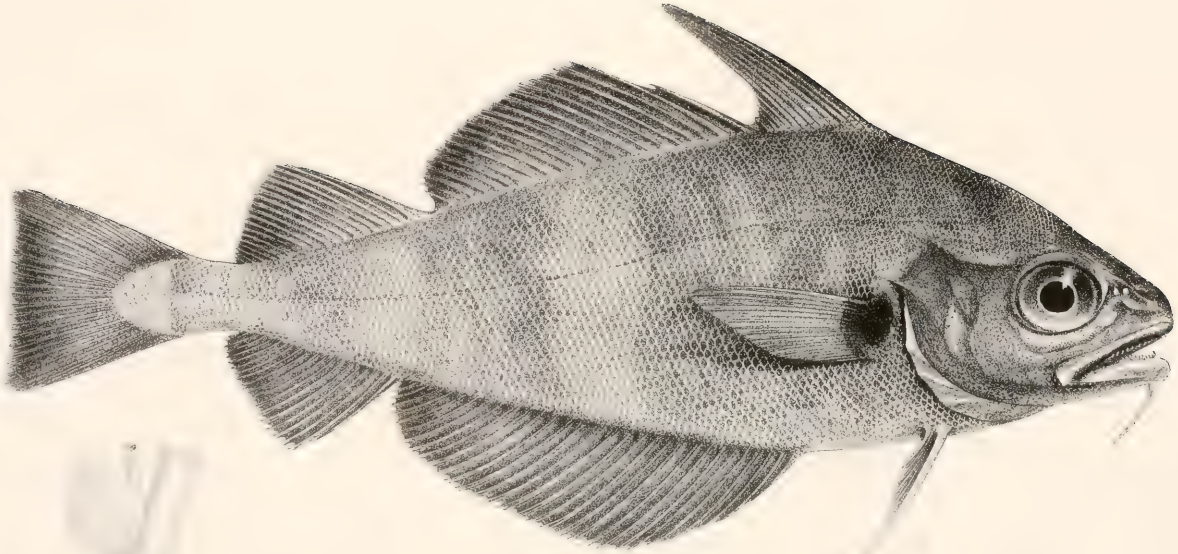
a. Stomach and pyloric appendages.



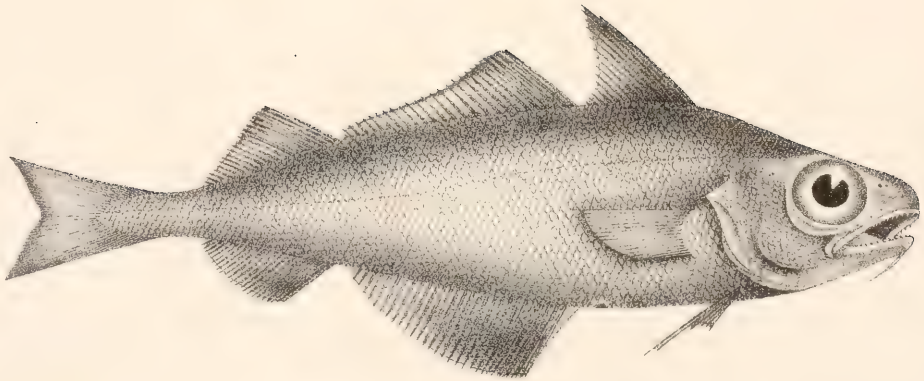
F. Day del C. Achilles lith.

Mintern Bros imp.

GADUS ÆGLEFINUS.
A. Stomach and pyloric appendages.



ADUS URCUS.



F. Day del. A. Hammond lith.

Hanhart imp.

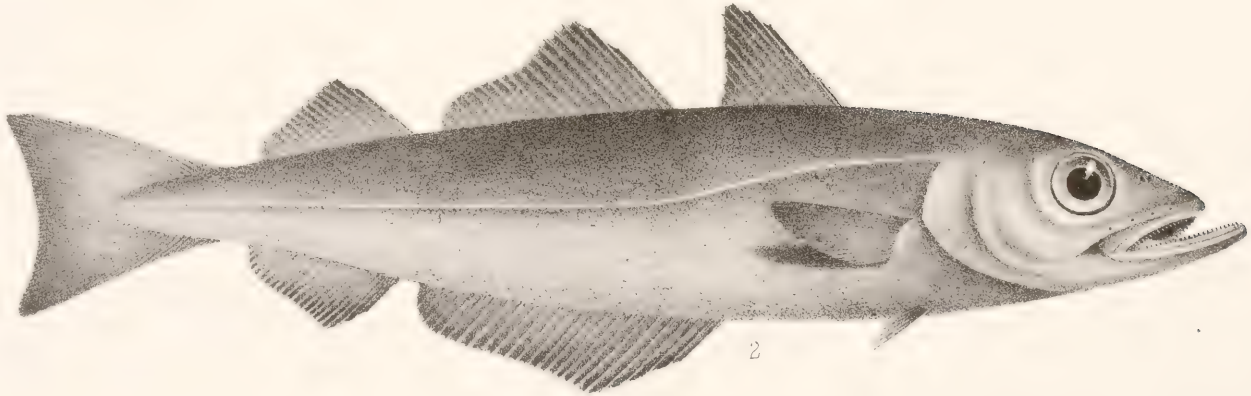
GADUS MINUTUS

F Day. del. C. Achilles lith.

Mintern. Bros. imp.

GADUS MERLANGUS.
A. Stomach and pyloric appendages.

1



2

Day del. A. Hammond lith.

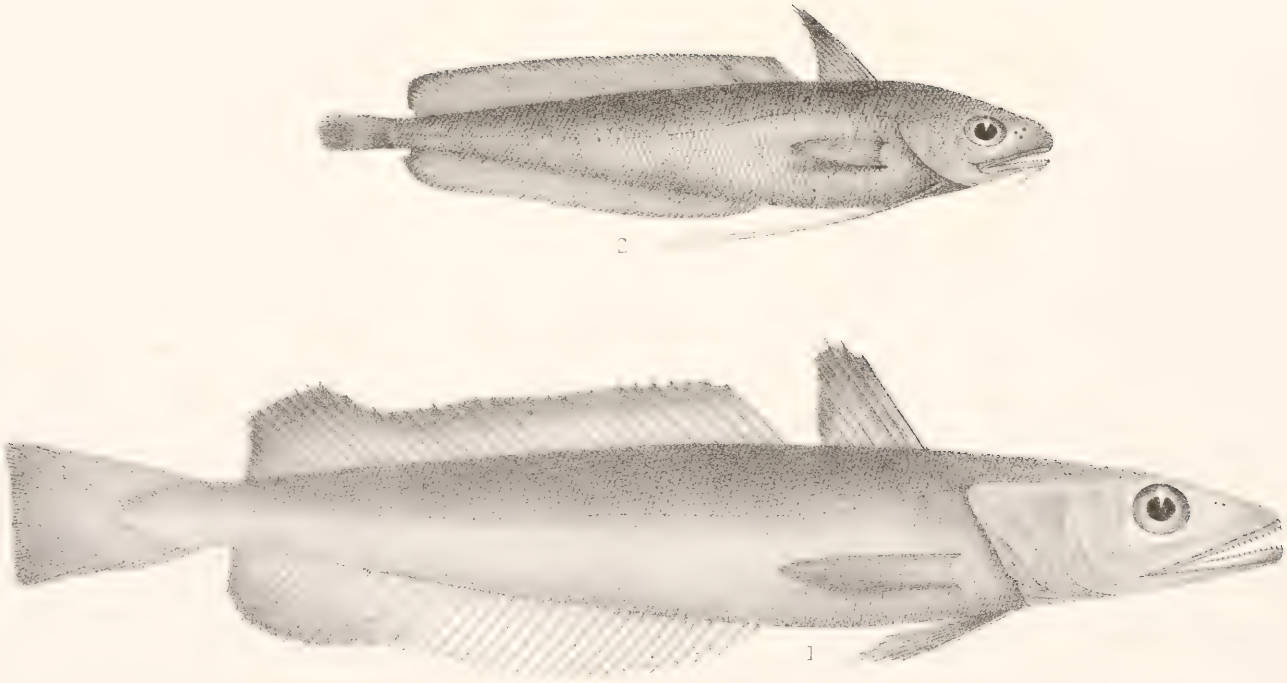
Hanhart imp.

1 GADUS POUTASSOU 2 G POLLACHIUS

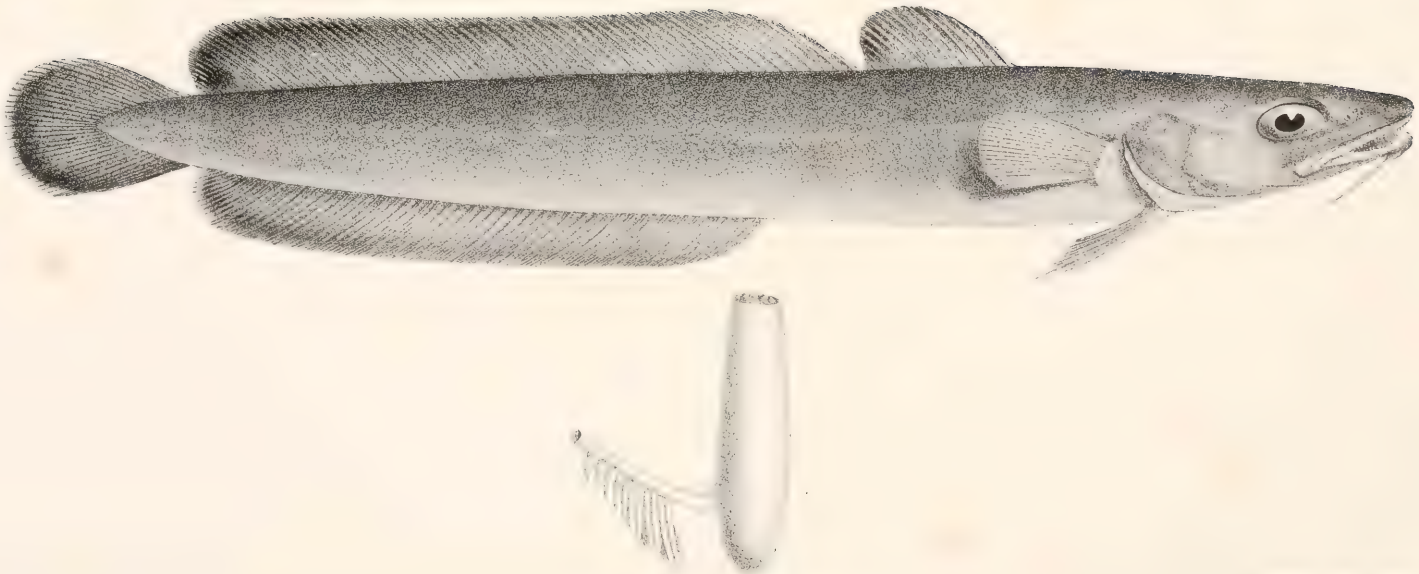
E. Doy del. Achilles lith. Mintern Bros. imp.

GADUS VIRENS.

a. Stomach and pyloric appendages.



1 MERLUCCIUS VULGARIS 2 PHYCIS BLENNOIDES

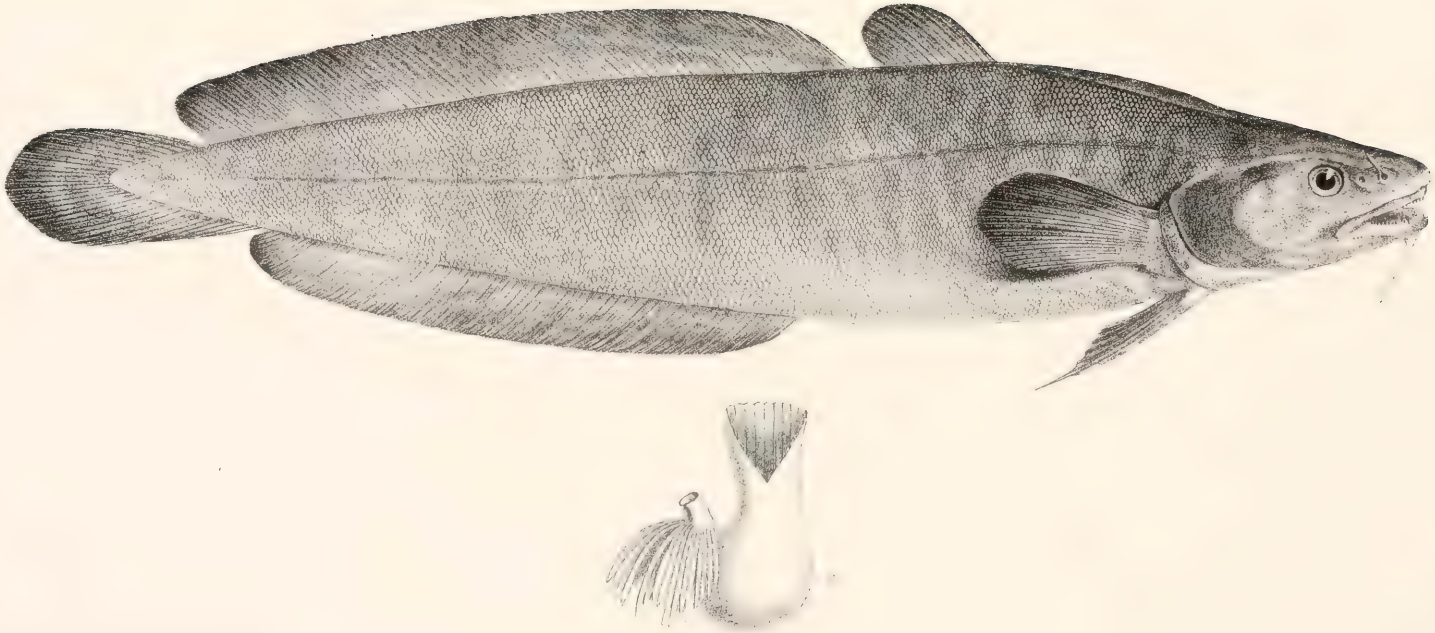


F. Day del. C. Achilles lith.

Winter Press imp.

MOLVA VULGARIS.

a Stomach and pyloric appendages.

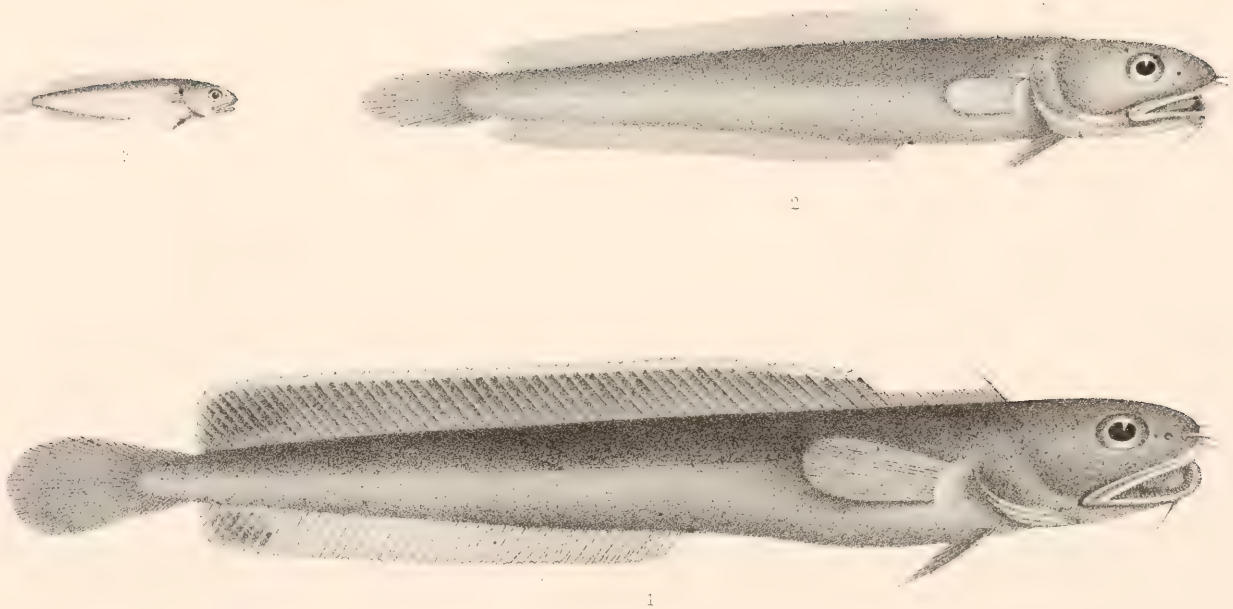


F. Day del. C. Achilles lith.

Mintern Bros. imp.

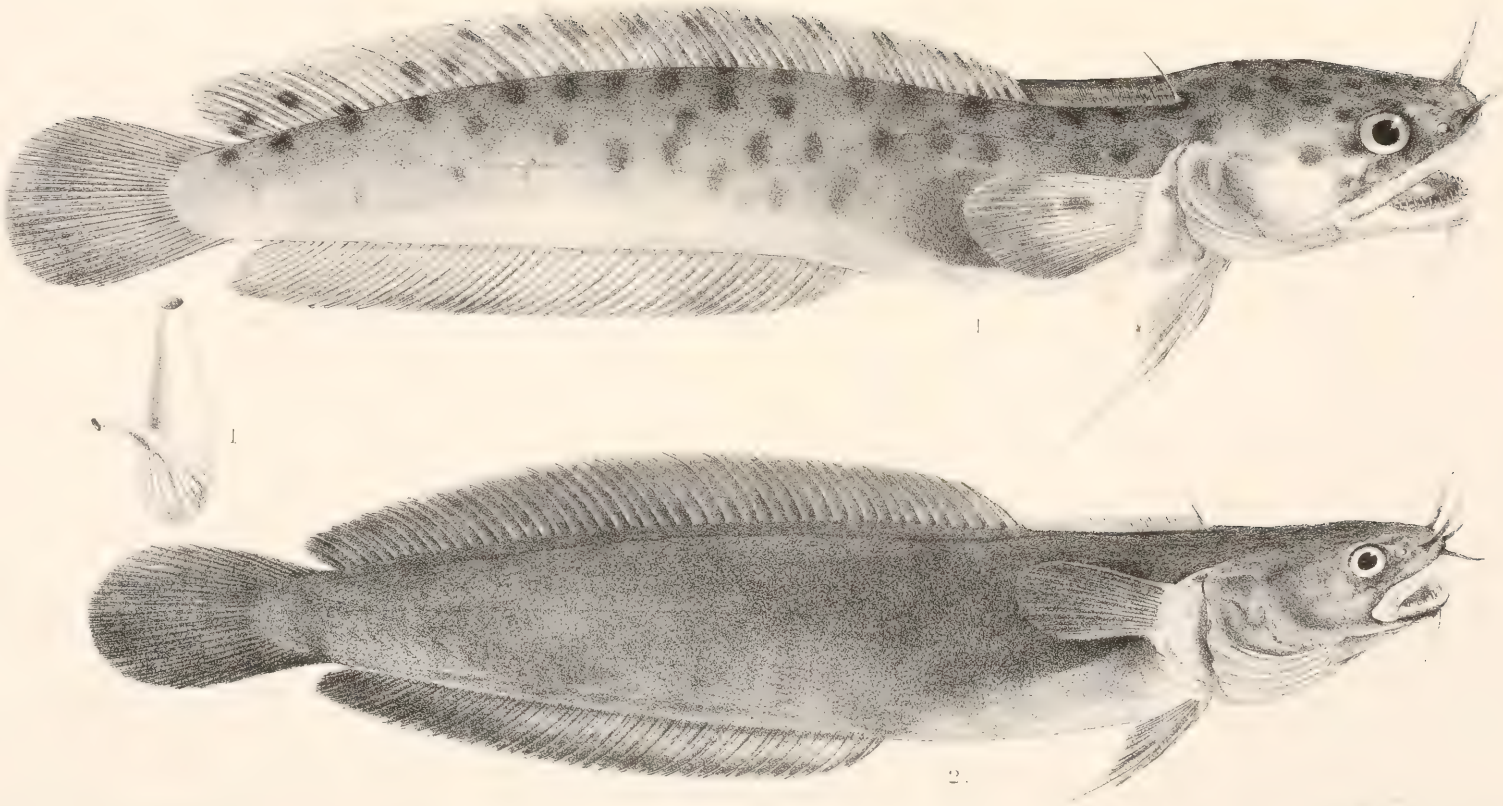
LOTA VULGARIS

a Stomach and pyloric appendages



F. Day del. A. Hammond lith. Hanhart imp.

1. MOTELLA CIMBRIA 2. M. MACROPHTHALMA 3. M. TRIGIRRATA (*Young*)

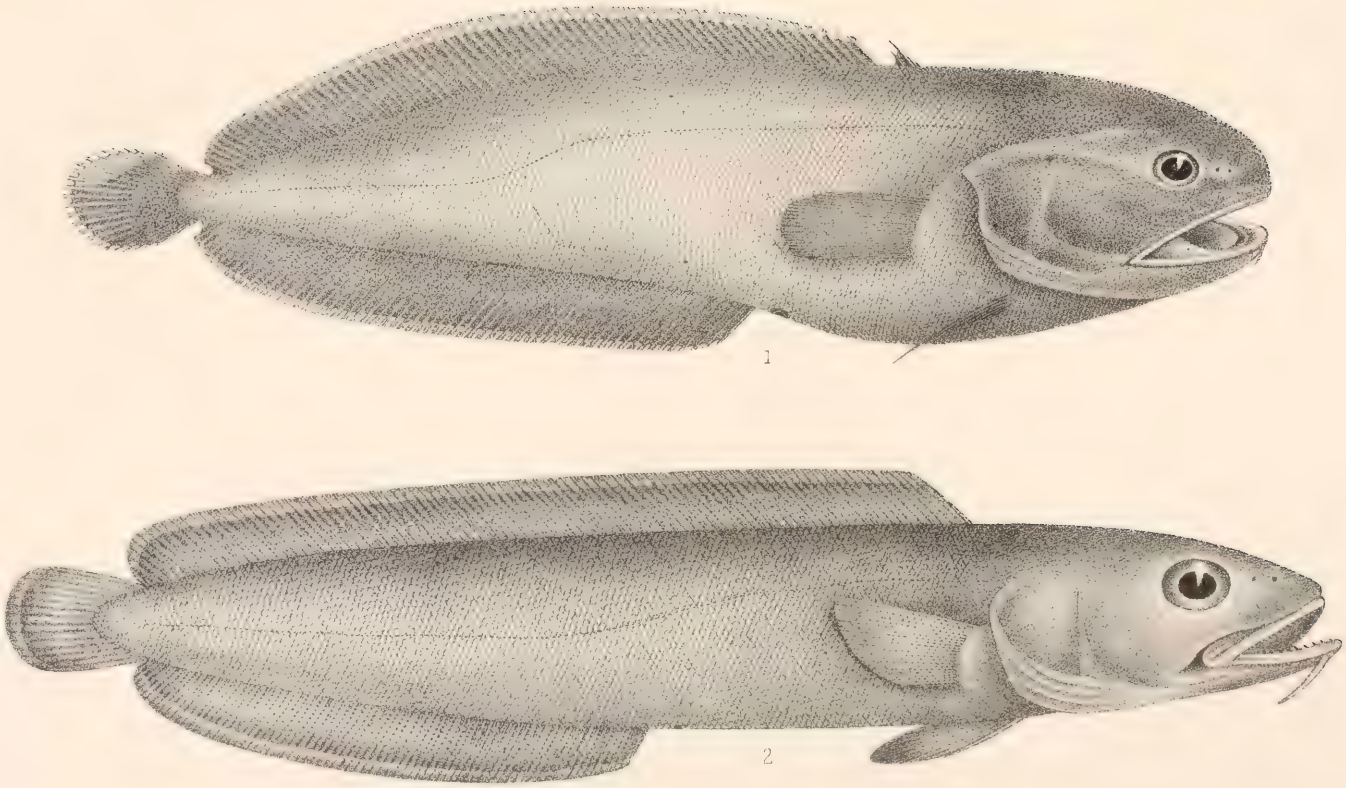


F. Day del. C. Achilles lith.

Mintern Bros imp.

1. MOTELLA TRICIRRATA. 2. MOTELLA MUSTELA.

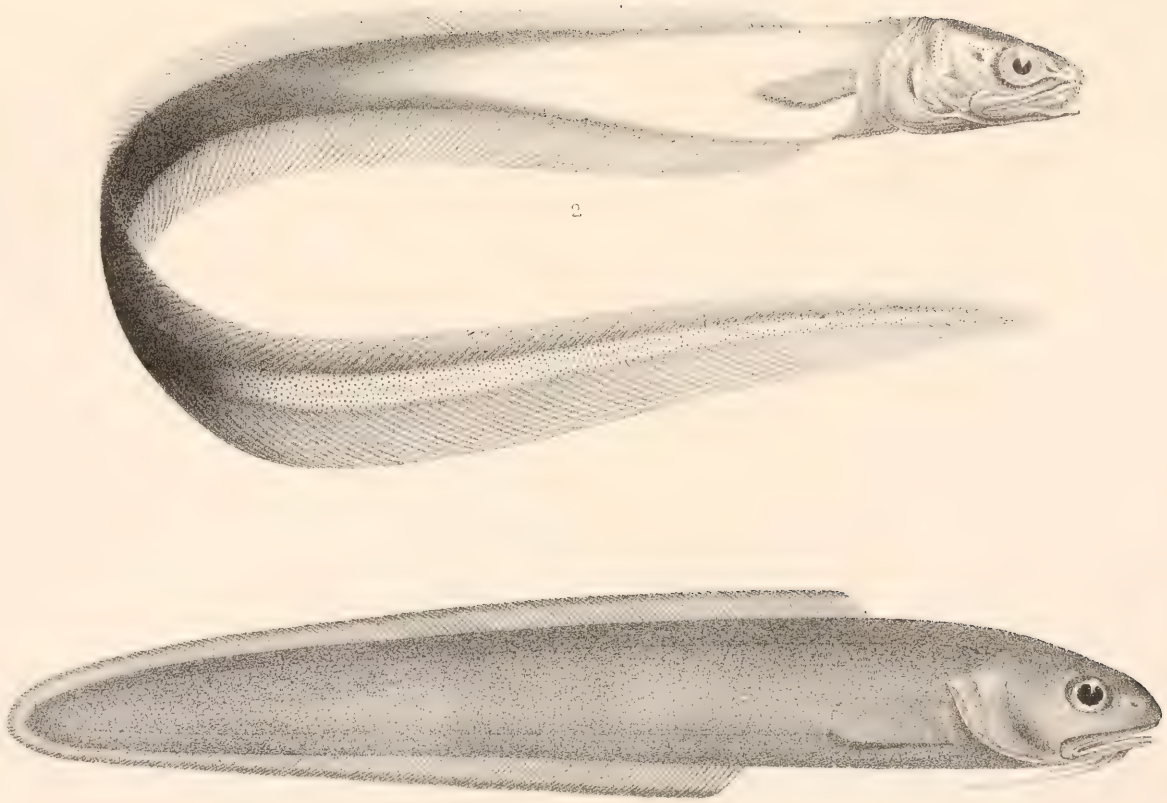
1a. Stomach and pyloric appendages.



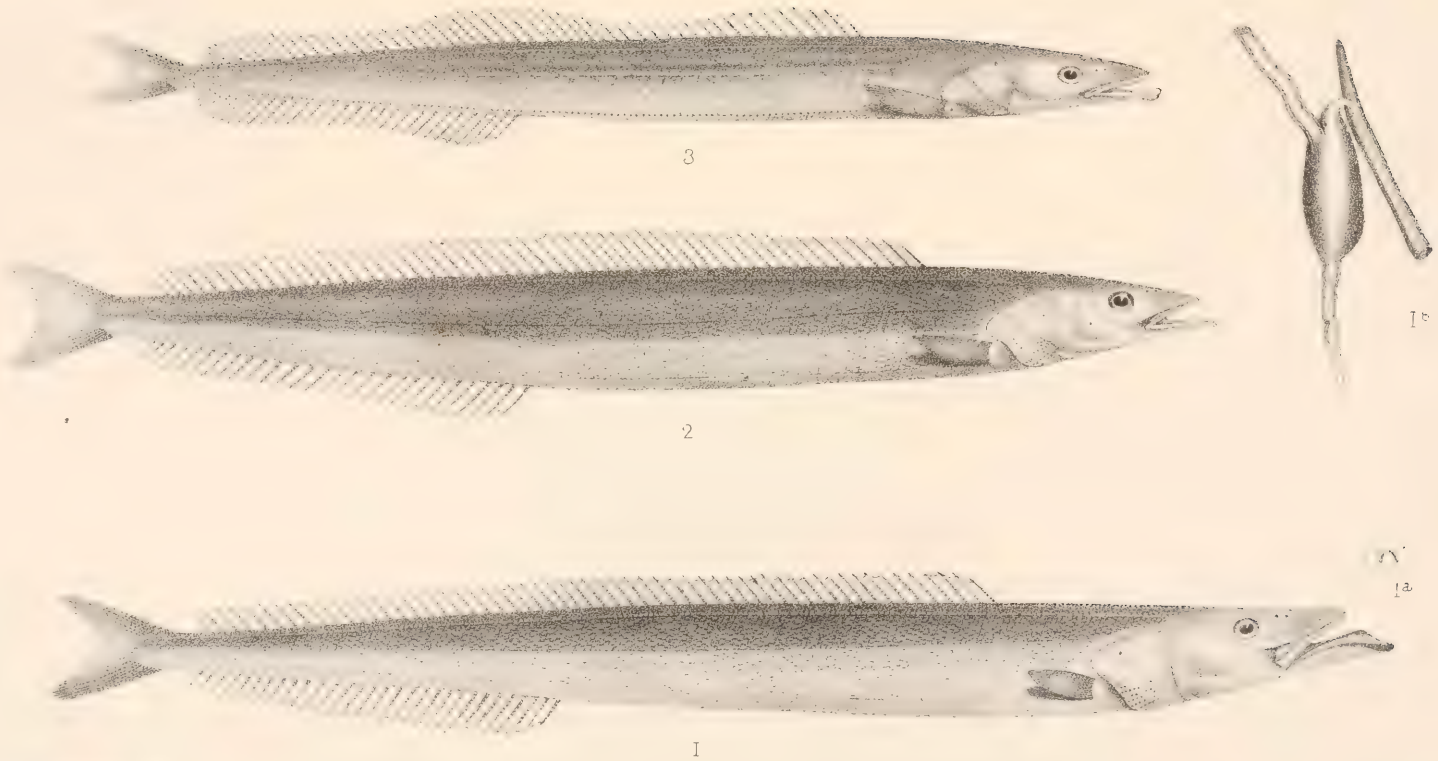
F Lay del A Hammond lith

Hanhart imp

1 RANICEPS RANINUS 2 BROSMIUS BROSME



1 OPHIDIUM BARBATUM 2 FIERASFER [illegible]



F Day del. A Hammond lith. Harkant imp.

1 AMMODYTES LANCEOLATUS 1a END OF VOMER 1b STOMACH AND PYLORIC APPENDAGE.
2. A. TOBIANUS 3 A. CICERELLUS

Hanhart imp

CORYPHÆNOIDES RUPESTRIS